JOURNAL

OF

THE FRANKLIN INSTITUTE,

OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY.

MAY, 1847.

CIVIL ENGINEERING.

Report of the Commissioners appointed by the Legislature of the State of New York, by the Act of May 11, 1846, *to locate certain portions of the New York and Erie Railroad, made to the Legislature, January* 14, 1847.

(Continued from page 230.)

Sullivan County or Interior Route.

It has been shown that the train will proceed from Deposit to the mouth of Callicoon Creek with a load due to a level, or a grade descending 15 feet per mile; the load being restricted by the return load to 358 tons freight. The extra power required to carry this load up a grade of 45 feet per mile is 2·34, or 2⅓ engines of equal power. We have then $40 \times 2 \times 2{\cdot}34 \times 1{\cdot}5 = 280{\cdot}8$ cents per mile run with a load of 358 tons, $280{\cdot}8 \div 358 = 0{\cdot}78$ cents per ton per mile.

The distance on which this grade rules, as before remarked, between the mouth of the Callicoon and Wurtsboro, is 52·58 miles; but, as it is to be compared with the Delaware river line from the mouth of the Callicoon to Port Jervis, it should be taken for extra power for no greater distance than that between the two latter points, or 48·97 miles. The extra power will therefore be taken for this distance.

This route is 2·61 miles longer than the Delaware river route. The extra length will be estimated the same as that for extra length of the Nineveh route, viz: at one cent per ton per mile on freight each way; or, charging wholly on freight moving eastward, 1½ cents per ton per mile.

Summary of extra cost of transportation on Sullivan county route, charging the whole cost on freight moving east:—

48·97 miles, at 0·78 cts. per ton per mile,	38·19 cts. per ton.
2·61 " extra length, at 1½ cts. per ton per mile,	3·48 " "
Total extra cost per ton over the Delaware river route,	41·67 cents.
Extra cost on Nineveh route, as before shown,	22·57 "
Total extra cost on the interior routes,	64·24 "

Having determined the extra cost of transportation per ton, caused by the heavy grades and extra lengths, it becomes necessary to ascertain what will be the total tonnage annually transported over the road. The calculations are all based on charging the whole expense of extra power on freight moving eastward; that moving westward being provided for by the method adopted to determine the question. It is therefore the tonnage moving eastward that we want to ascertain the amount of.

The officers of the New York and Erie Railroad Company, in presenting their views of this question to the Commissioners, assumed that 500,000 tons per annum would be transported eastward over the railroad. This position was not controverted by any person interested in the Northern or other routes.

It is not possible to arrive at accuracy on this point; and the Commissioners are not willing to say the road will not eventually reach this estimate: but this would be a very large business for a general trade, and much beyond the capacity of a single track road. The question to be determined is, what amount of trade will pass over the section between the Shawangunk ridge and Port Crane, in Broome county.

An estimate of this kind should look to some future period, when the business of the road might reach, not its full capacity, but such as would form an average with the past and the future.

The Baltimore and Ohio railroad, as now, and for several years past, has been worked about 180 miles. For the year ending September 30th, 1846, there was transported on it, to and from the different points, 193,916 tons, (including the trade in both directions,) equivalent to about 84,000 tons carried over the whole road.

The New York and Erie railroad, when completed, will extend about 260 miles beyond Port Crane, in Broome county. Now, if we suppose 3 tons carried to Baltimore, to 1 ton in the opposite direction, there must have been about 145,000 tons moved towards Baltimore. This proportion applied to the New York and Erie railroad, for equal distances, would show about 210,000 tons arriving at the western end of the routes under consideration. Whether the two roads should be

regarded as presenting a fair parallel for amount of trade, is, however, a question which may admit of a difference of opinion.

The tonnage on the western railroad, from Albany to Worcester, 156 miles, for the year 1845, was equal to 93,392 tons carried over the whole road. This includes freight in both directions. On this road the freights in opposite directions are more nearly equal than is usual. Judging from the amount received for freight, it appears to be not far from two to one. This would show a result about 13 per cent. greater for the tonnage towards tide water, comparing the distances, than the Baltimore and Ohio railroad. It is to be considered, however, that a considerable portion of this tonnage is from place to place, and forms no part of the through tonnage.

The route traversed by the New York and Erie railroad is understood to be in general a grazing district, that furnishes freight of greater value but of less tonnage than a grain growing district.

The Commissioners have been much embarrassed in forming a satisfactory estimate on the amount of tonnage. It does not appear practicable, from any data in their possession, to reach any definite accuracy, and their estimate must be considered as in a great measure conjectural.

The amount assumed by the engineer of the Company is regarded as too high to form the basis of comparison between the several routes. The Commissioners have assumed 200,000 tons as the annual amount of freight that may be expected to move eastward over that portion of the road embraced in this question of location; this, they think as high an estimate as they are warranted to make for this comparison.

It has been shown the cost of transportation will be 64·24 cents per ton (computed wholly on freight moving eastward) greater on the interior routes than on the river routes.

This rate on 200,000 tons per annum, is 200,000 tons at 64·24 cents per ton, = $128,480.

The passenger trade will feel the unfavorable influence of the heavy grades, and will require extra power; or, the train must proceed over them at reduced velocity.

The excess of curvature on the Nineveh, and the Sullivan, or interior routes, over that on the river routes, is 3903 degrees, or equal to 10·84 (nearly 11) entire circles. The excess of curvature is mostly on radii of less than 1000 feet, and frequently occurs on the heavy grades. It will no doubt increase the expense of power. The Commissioners are not aware of any definite data, by which this question can be reduced to computation. Heavy curving on railroads is regarded to be the next unfavorable thing to heavy grades, and great expenses are often incurred to reduce the curves to large radii, or dispense with them altogether.

Not only is more power required to move the train, but the displacement and wear of rails, and the wear of cars and engines is much greater on sharp curves than on a straight line. On the Nineveh and Susquehanna lines, an allowance of 10 feet per mile, or 15 per cent., was made for the curve lines: whether this is sufficient for the extra power is doubtful. On the Sullivan county lines no such allowance

was made. If it had been, it would have increased the maximum grade in the same proportion. If the same rule be applied to this, it will raise the total cost of extra power to nearly 70 cents per ton.

Regarding the extra wear of rails, cars, and engines, this great excess of curvature, though not susceptible of a definite reduction, must be considered as a very serious objection to the interior lines, when viewed only in connexion with the freight business. Its influence on the passenger trade, exposing the cars to leave the track, causing greater wear to the road and machinery, and restricting the speed of traveling, is still more serious.

The interior routes will be more obstructed by heavy snows (especially that in Sullivan county) than the river routes, which will increase the expense of running, and cause delays that will be prejudicial to the business of the road during the winter season.

Heavy grades cause extra wear on the rails, cars, and engines, from the more frequent and severe application of the friction brake, to control the latter in their descent. The cars on the heavy grades would not stand still without being secured, and consequently, any accident by which a car should get loose, would allow it to move off with great velocity, putting at hazard its own safety, and that of others that might be in its way. Any circumstance that should disable an engine in ascending a heavy grade, such as the slipping of the wheels, or the machinery suddenly getting out of order, would put the whole train at hazard.

On a long line, where the passenger traffic will be important, the excess of heavy grades and curvature on the interior routes will have a material influence on the economy and usefulness of the road.

The several points of disadvantage that appertain to the interior routes, as above considered, namely—the influence of the great excess of curvature on the freight traffic, together with that of the heavy grades on the passenger traffic—the greater exposure to heavy and drifting snows—extra wear of rails, cars, and engines, on the excess of heavy grades and curvature—with the greater hazard of accident and consequent damage, are of a character that does not admit of any definite computation. They are, however, of such importance, that heavy expense, where a change of route is practicable, may well be incurred to avoid them. That they materially impair the value of a railroad, is beyond question. After careful consideration, the Commissioners have come to the conclusion that, collectively, they will not be less than half the amount before stated, as the excess on the freight traffic caused by the excess of heavy grades.

The total amount of excess chargeable, as before presented, to the interior routes, is:—

On freight arising from heavy grades,	$128,480
On items above enumerated, collectively assumed at 50 per cent. of the above,	64,240
	$192,720

From this, there must be deducted:—

First, The extra cost of constructing and maintaining the Southern line.

Second, The annual tax imposed by the state of Pennsylvania.

In relation to the first, the estimates of the engineers show the extra cost to be $519,821. To this must be added the interest that will accrue on the expenditure until the road is in operation, and receiving income from its business. This will, of course, depend on the vigor with which the work is prosecuted, and the facility with which its traffic may be advantageously commenced. It is supposed ten per cent. on the whole sum would provide for all the accruing interest, making the capital invested for this item $571,803. The river routes, more particularly that along the Delaware, from the heavy bridges that must be maintained, and from the exposure of the work to the floods of this river, will be more expensive to keep in repair than the interior routes. This item is estimated at $15,000 per annum.

The second item, the tax imposed by the State of Pennsylvania, is chargeable when the whole road is completed to Dunkirk, or connected with some road leading to Lake Erie.

This annual bonus will not, therefore, be chargeable until the road is in full operation.

The annual charge will be as follows:—

Interest on $571,803, at 6 per cent.,	$34,308
Annual repairs—excess, - -	15,000
Bonus to Pennsylvania, - -	10,000
	$59,308

Summary of excess:—

On the interior routes, - -	$192,720
On the river " - -	59,308
	$133,412

Showing that the annual expenses on the interior routes will be $133,412 greater than those on the river routes. This result has been reached, after carefully considering and yielding every advantage to the interior routes which can be regarded as belonging to them. The mode of working on which the calculation is based, is the most favorable to them, involving the most careful attention to the economy of motive power; and the Commissioners feel constrained to say, that they have serious doubts whether a more expensive arrangement in relation to motive power, would not, on account of greater simplicity, be found more expedient in practice.

Herewith are submitted a map and profile, marked A, of the Nineveh and Susquehanna lines; a map and profile, marked B, of the Sullivan county and Delaware river line; a profile, marked C, of the several routes from Binghampton to the Shawangunk summit; and a profile, marked D, of the whole line of the New York and Erie railroad, from Piermont to Dunkirk. These have all been prepared

under the directions of the Commissioners, and from surveys, also under their directions, except the general profile, which is from such surveys only on those portions that have come under the examinations of the Commissioners. From these maps and profiles, a good idea of the general features of the several routes may be obtained.

Tabular statements of the results of the surveys by Henry Tracy and James O. Morse, Esqrs., the engineers employed by the Commissioners, are also herewith submitted.

The Commissioners are required to take into consideration "the terms, conditions," &c., of the Act of Pennsylvania, authorizing the New York and Erie Railroad Company to construct a portion of their road in that State.

There are several conditions in the Act of the Legislature of Pennsylvania that are peculiar, and require the notice of the Commissioners.

First. The railroad, if constructed along the Delaware river, is required to "be so constructed as not to obstruct the rafting navigation, nor contract the natural flow (and expansion) of the said Delaware river, (at high floods,) nor injure the works," &c., of the Delaware and Hudson Canal Company; and in relation to the point of crossing the Delaware river. Similar provisions are contained in the Act of this State which constituted this commission.

On all these points the engineer employed by the Commissioners was instructed to conduct his surveys, and make his estimates with a view to a full compliance with these provisions.

Second. The 3d section of the Act of Pennsylvania requires certain laws to be passed by the Legislature of this State; it also requires from the New York and Erie Railroad Company, conditions in relation to the conduct of their business, which have been considered matters for said Company to look to, before they could legally locate their road in that State; but not requiring the attention of this commission.

Third. The 5th section of said Act requires that after the said railroad is completed to Dunkirk, or connects at its western termination with any improvement extending to Lake Erie, said Company shall pay to the State of Pennsylvania ten thousand dollars per annum. This is presumed to be the main condition to which the attention of the Commissioners was called, and they have placed it as an annual charge against the routes in that State. It is certainly an onerous and extraordinary burden to be imposed on a Company for the privilege of constructing a work that, in its results, must be a great benefit to a large portion of the citizens of that State; but it is a condition, and the Commissioners can do no less than place it to the debit of those routes.

By the Act of May, 1846, the Commissioners are directed to take into consideration "a comparison of the grades or elevations, and depressions and curvatures, in the line or track of said railroad, in the other counties east and west of Sullivan county."

The Commissioners have no means of judging of the curvatures east and west of Sullivan county, except on the routes surveyed under their directions, which present no curvatures so unfavorable in degree,

nor much exceeding half the amount, as compared with equal distances.

There are grades, both east and west, more unfavorable than occur in Sullivan county, and it was contended by the friends of the interior route in that county, that this was sufficient, under the Act, to settle the location on that route. Now, (as stated in the preliminary remarks of this report,) it was a matter of public notoriety, before the Act was passed, that grades equally heavy as those in Sullivan county existed both east and west of it; but as this question has been discussed, and the views of the Commissioners given, in the preliminary part of this report, it is not deemed necessary to enter into further detail here on this point.

If the heavy grades in this county were so situated, in regard to the heavy grades east and west of it, that no material benefit could be obtained by avoiding them, then the construction of the Act above given, by the friends of the Sullivan county route, would, no doubt, be in accordance with the intention of the Legislature. But inasmuch as they are so situated that heavy extra expense would be incurred in conducting the traffic of the road over them, such construction would be equivalent to the position, that serious obstacles on one part of the line were sufficient reason that others of the same kind constitute no impediment to the enterprize, which position is considered as inadmissible, in view of the general object of the Act. It is well known that the heavy grades which occur on several parts of the route of the New York and Erie railroad, have been great impediments in the progress of that enterprize; and, consequently, its friends have endeavored to reduce such obstacles as much as possible. The application for the law establishing this commission had its origin in this effort, and the original law (of which the present is an amendment) had a reference to the same object, namely: to remove some of the impediments (of this character) to the progress of the improvement. The Commissioners are, therefore, fully of the opinion, that the construction they have given to the Act is the proper one, namely: that "this fact is to be candidly considered, and to have its due influence on their decision, but cannot control irrespective of all other facts that bear on the question;" and especially cannot do away with the main object of the Act, which was, to determine whether those grades could be adopted "without great prejudice to the public interest."

The Commissioners are further required to take into consideration, "the several Acts of the Legislature of this State in granting aid to the said Company, and especially the provisions of the Act mentioned in the first section of this Act."

The Act incorporating the New York and Erie Railroad Company was passed in 1832. It authorized the construction of a railroad through the southern tier of counties, and forbids any connexion with railroads in the States of Pennsylvania and New Jersey without the consent of the Legislature of this State. Stock sufficient to organize the Company not being obtained, a subsequent Act was passed, authorizing an organization when one million of dollars was subscribed to the stock. No progress having been made in 1834, the Legislature

authorized a survey of the route for said railroad at the expense of the State. In 1835, an Act was passed authorizing the Company to construct and put in operation such sections of the road as they might deem eligible.

The powers and privileges granted by the several Acts of the Legislature, and prospects of remuneration from the business of the road having failed to command private capital sufficient for the work, "an Act to expedite the construction of a railroad from New York to Lake Erie," was passed in 1836. This Act authorized a loan of the State credit for three millions of dollars, to be advanced in several sums, on the completion of certain sections of the said railroad.

This Act did not secure much progress in the construction of the road. Private capital could not be obtained sufficient to complete the "first section" of road necessary to obtain any portion of the loan of the State credit.

In 1838, the Legislature passed an Act to amend the Act of 1836, above mentioned. This Act authorized the loan of the State credit to be made, in equal sums with, and after the expenditure of, private subscription; to commence after the Company should expend three hundred thousand dollars.

In 1840, an Act was passed to amend previous Acts; authorizing a six per cent. State stock to be loaned to the Company, and the stock to be issued on the expenditure, by the Company, from their own means, of half the amount of the same.

Under this Act, the Company proceeded with the work until the loan on the credit of the State was issued, to the amount of three millions of dollars, as authorized by the several acts above mentioned. Failing to command the requisite means to carry forward the enterprize from subscriptions to the stock of the Company, after the State loan was exhausted they were unable to proceed with the work, and, early in 1842, notified the State authorities that they were unable to pay the interest on the State loan. This circumstance authorized the Comptroller of the State to sell the road and its appurtenances after six months notice. The sale was postponed by the authority of the Legislature. At this time the Company were practically insolvent, and had no more than a nominal existence. But the Legislature did not seem disposed to abandon the project, and, in 1843, passed a law authorizing the said railroad Company to issue bonds to the amount of three millions of dollars, and giving these bonds priority to the State lien. Also providing, that the State may take the road on certain conditions, when finished; and if the State should not elect to take the road on such conditions, then, the said Company to be released from all liability for the payment of the State stock heretofore issued to them, and amounting to three millions of dollars. After the passage of this law, a new Board of Directors were elected, composed of highly intelligent, honorable, and influential citizens, who made vigorous efforts to raise the funds necessary to carry forward and complete the enterprize. Capitalists, however, did not feel sufficient confidence in the success and productiveness of the enterprize to furnish the necessary funds; and the Board who had taken the direction, finding they

were not sustained in their efforts, yielded the administration of the affairs of the Company to others. Nothing, however, in the way of progress was accomplished, and the work remained stationary until 1845. At that time, it became obvious that no further progress could be made by private enterprize, unless inducements could be presented that would secure a large addition of subscriptions to the stock of the Company, under which a new organization could be effected, and a new impulse given to the project. This was the condition of the enterprize when the Act of 1845 was passed—the Act we are called upon particularly to consider.

This Act passed May 14th, 1845, provided, that a new subscription to the stock of the Company should be obtained to the amount of three millions of dollars, and, under certain restrictions, bonds were authorized for a like amount. It provides for a release of the lien of the State on account of the loan of its credit for three millions of dollars, provided a single track road be completed within six years from the passage of the Act. It established a commission of three persons, who were authorized to survey and examine the routes between the summit of the Shawangunk and Deposit, and decide whether a practicable route did exist, and one that could be adopted "without great prejudice to the public interest;" but did not authorize any location out of the State as a substitute for that through Sullivan county.

The same commission was authorized to examine the routes between Deposit and a point one mile westerly of Binghampton, with power, under certain circumstances, to locate on the route by the Great Bend of the Susquehanna, passing so far in the State of Pennsylvania as might be necessary for that route.

At the time this Act was passed, an Act had been passed by the State of Pennsylvania, authorizing the said Company to construct a portion of their road in that State, so far as necessary to occupy the route by the Great Bend of the Susquehanna; but they had not authorized the Company to occupy any portion of that State in the valley of the Delaware river.

To induce the subscription of three millions, and thereby secure the completion of the railroad, the Legislature of 1845, by the Act above mentioned, prospectively gave up the lien of the State for the three million loan, on the conditions above mentioned; they authorized, under certain restrictions, the railroad to pass through a portion of Pennsylvania, and thereby secure a more favorable line; also to consolidate the old stock.

Under this Act, the Company and its friends undertook to revive the affairs of the enterprize. The first proceeding was to obtain the subscription of three millions of dollars to the stock of the Company; without this, nothing could be done. The steps taken to procure it, showed that many persons were more ready to advocate the project than to furnish funds to carry it forward, and (notwithstanding the State prospectively released its lien on the road—the old stockholders submitting to a loss of half their stock—having the prospect of being allowed an improved route for an unfavorable portion of the line) they did not succeed in accomplishing this preliminary step without

great efforts, continued for months together; and their final success may be attributed far more to the general influence the road was expected to produce on the trade of New York than to the dividends that would be made from its earnings.

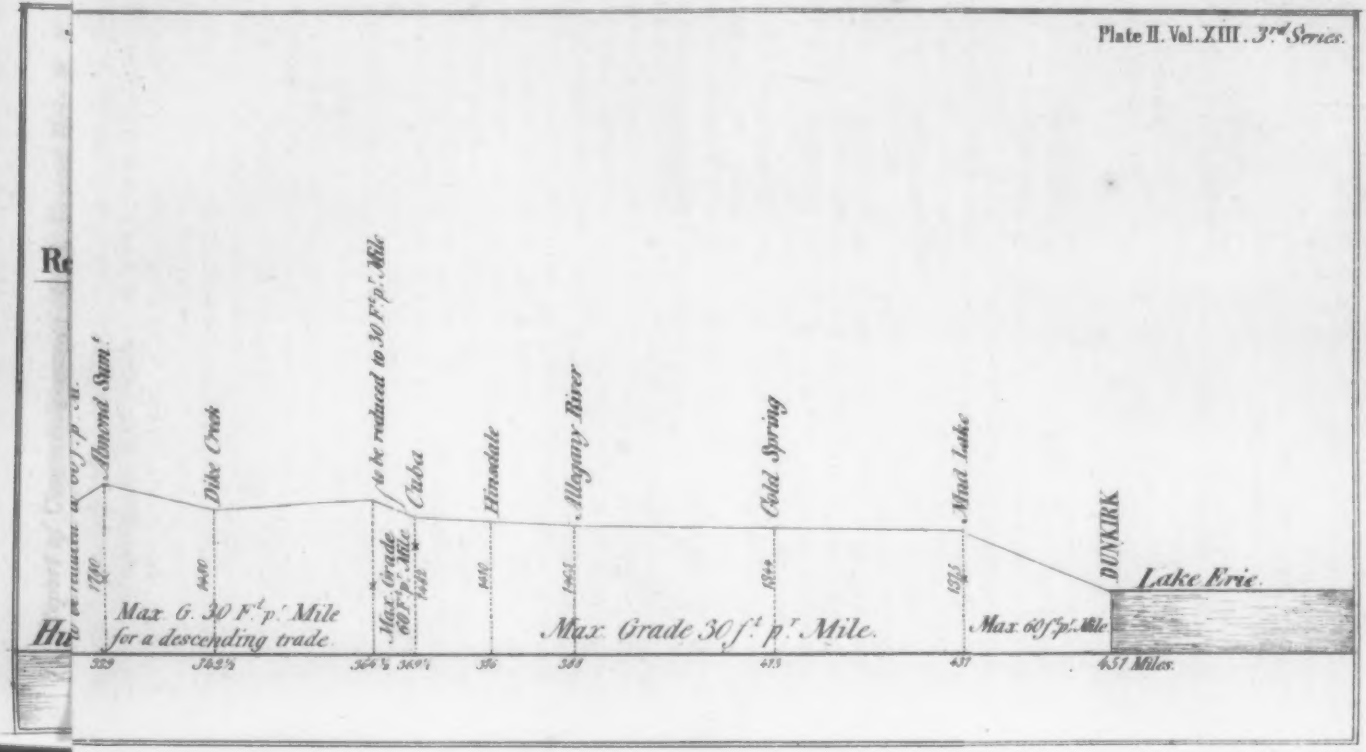
The Commissioners can regard the law of 1845 in no other light than as emanating from a desire, on the part of the Legislature, to offer such further inducements to private capital as would be sufficient to secure the early accomplishment of this great improvement, and thereby afford to a large district of the State, now very much secluded, the means of easy communication to and from our great commercial centre. Subsequent events have proved that the inducements offered were barely sufficient to obtain the requisite subscription, upon which the new organization has been established. To show the slender hold the new subscription had on the stockholders, it is only necessary to mention that, before and at the time the decision of the Commissioners was made on the question of location, shares of stock, on which 20 dollars had been paid, could be purchased in the market for two dollars. In this state of the affairs of the Company, they were not in a condition to encounter difficulties which they regarded as onerous and unnecessary, and from which they had indulged the hope of being relieved. The Commissioners cannot say the work would have been abandoned if their decision had confined the line to this State; but, under the circumstances that existed, they were of the opinion, that such a decision would have put in jeopardy the progress of the enterprize.

It was clearly the intention of the Legislature to confine the route to this State, unless it should be found there were urgent considerations for carrying some portions of it through Pennsylvania, and the Commissioners were, without exception, extremely desirous of confining the location to this State It was an unpleasant duty to carry the line into another State, that demanded compensation for the benefits that would be conferred on her citizens; while a portion of our own, that had contributed their exertions to secure its benefits, were thus deprived wholly, or in part, of the anticipated advantages. The law, however, under which this commission was established, contemplated the contingency of such decision. It was doubtless framed in view of the necessity that might be found to exist to abridge the benefits to a comparatively small number, in order to make it more beneficial to the public, and to secure the accomplishment of a great work that would confer its benefits on a large portion of the population of this State.

To illustrate the views of the Commissioners as to the influence the extra cost of conducting the traffic will have on the prosperity of the project, they remark:—

First.—It cannot be expected that an enterprize of this magnitude will be undertaken by private capital without a fair prospect of reasonable remuneration for the outlay required.

Second.—If the road be constructed in such a manner as to involve large expenses in conducting a given traffic, such expenses must be charged to those interested in the traffic, and, consequently, the value


Almond Stm.
Dike Creek
to be reduced to 30 F.s p.r Mile
Cuba
Hinsdale
Allegany River
Cold Spring
Mud Lake
DUNKIRK
Lake Erie.
1780
1480
1510
1440
1365
1845
1575
Max. G. 30 F.t p.r Mile for a descending trade
Max. Grade 60 F.t p.r Mile
Max. Grade 30 f.t p.r Mile.
Max. 60 f.t p.r Mile
329
342 1/2
364 1/2
369 1/2
386
389
419
431
451 Miles.

of the improvement to the community who use it, depends on the economy with which its business may be conducted.

Third.—Whatever tends to increase the cost of conducting the traffic of a road, reduces its power of competing with other roads, or other modes of conveyance, and consequently diminishes its prospects of business and the inducements to prosecute the enterprize.

Fourth.—The facts and computations, before presented, show that the interior routes would involve annually a heavy extra expense, materially affecting the prospects of the enterprize, and consequently hazarding its success.

The legislation of this State is a full demonstration of the difficulty that has attended every effort to obtain from private sources the funds necessary to carry forward this work, and the necessity of relieving it from every natural impediment, in order to accomplish the main object for which it has been undertaken; and although in the origin of the enterprize the Legislature was disposed to confine the line strictly to this State, in the progress of the undertaking, subsequent Legislatures have found it expedient, in order to secure to a large portion of the State its benefits, to recognize the possible necessity of some departure from the original design, and hence the establishment of this commission to ascertain the facts, and make such decision as the exigencies of the case should require.

That the river routes, when contrasted with the interior routes, have the decided advantage, cannot admit of a doubt, and with that fact established, the only remaining question which presented itself, was, whether the Commissioners were authorized by the Act to sanction those routes.

The Commissioners were required to adopt the interior routes, provided it can be done "without great prejudice to the public interest," &c. In arriving at this conclusion, they are required to consider:—

First.—"The public interest of this State." The public interest is doubtless promoted by the adoption of the route that will be most likely to secure the early construction of the railroad, and render the improvement most beneficial when completed. From the considerations and comparisons presented in the preceding pages, the Commissioners believe the interior routes, if adopted, would be greatly prejudicial "to the public interest of this State."

Second.—"The interest of the citizens of this State who, in their (the Commissioners') judgment, will be affected by the construction and location of said railroad, collectively considered." In examining this branch of the question, the Commissioners do not propose to notice remote interests.

There is, no doubt, a considerable number of citizens of this State that will be affected by the road, beyond the limits that are considered as specifically demanding consideration; but as these will have about the same relative bearing on the question with those more directly interested, it is not considered necessary to refer more particularly to them.

It can hardly be said that any portion of the citizens of the southern tier of counties will be injured by the construction of the railroad on

mention that, before and at the time the decision of the Commissioners was made on the question of location, shares of stock, on which 20 dollars had been paid, could be purchased in the market for two dollars. In this state of the affairs of the Company, they were not in a condition to encounter difficulties which they regarded as onerous and unnecessary, and from which they had indulged the hope of being relieved. The Commissioners cannot say the work would have been abandoned if their decision had confined the line to this State; but, under the circumstances that existed, they were of the opinion, that such a decision would have put in jeopardy the progress of the enterprize.

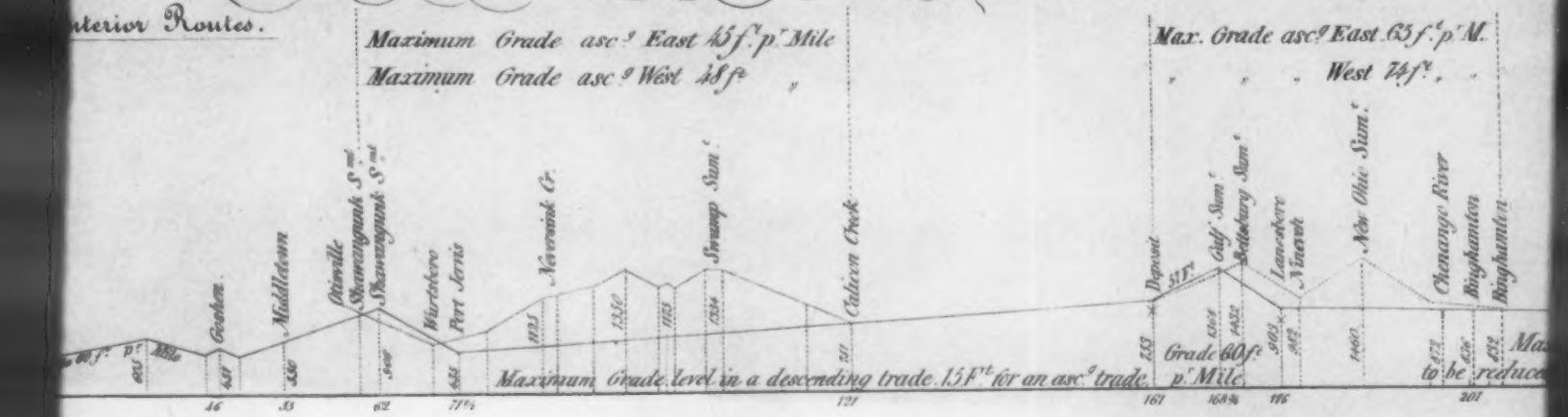
It was clearly the intention of the Legislature to confine the route to this State, unless it should be found there were urgent considerations for carrying some portions of it through Pennsylvania, and the Commissioners were, without exception, extremely desirous of confining the location to this State It was an unpleasant duty to carry the line into another State, that demanded compensation for the benefits that would be conferred on her citizens; while a portion of our own, that had contributed their exertions to secure its benefits, were thus deprived wholly, or in part, of the anticipated advantages. The law, however, under which this commission was established, contemplated the contingency of such decision. It was doubtless framed in view of the necessity that might be found to exist to abridge the benefits to a comparatively small number, in order to make it more beneficial to the public, and to secure the accomplishment of a great work that would confer its benefits on a large portion of the population of this State.

To illustrate the views of the Commissioners as to the influence the extra cost of conducting the traffic will have on the prosperity of the project, they remark:—

First.—It cannot be expected that an enterprize of this magnitude will be undertaken by private capital without a fair prospect of reasonable remuneration for the outlay required.

Second.—If the road be constructed in such a manner as to involve large expenses in conducting a given traffic, such expenses must be charged to those interested in the traffic, and, consequently, the value

Profile of the New York & Erie Rai



Lith. of Wagner & K

great efforts, continued for months together; and their final success may be attributed far more to the general influence the road was expected to produce on the trade of New York than to the dividends that would be made from its earnings.

The Commissioners can regard the law of 1845 in no other light than as emanating from a desire, on the part of the Legislature, to offer such further inducements to private capital as would be sufficient to secure the early accomplishment of this great improvement, and thereby afford to a large district of the State, now very much secluded, the means of easy communication to and from our great commercial centre. Subsequent events have proved that the inducements offered were barely sufficient to obtain the requisite subscription, upon which the new organization has been established. To show the slender hold the new subscription had on the stockholders, it is only necessary to mention that, before and at the time the decision of the Commissioners was made on the question of location, shares of stock, on which 20 dollars had been paid, could be purchased in the market for two dollars. In this state of the affairs of the Company, they were not in a condition to encounter difficulties which they regarded as onerous and unnecessary, and from which they had indulged the hope of being relieved. The Commissioners cannot say the work would have been abandoned if their decision had confined the line to this State; but, under the circumstances that existed, they were of the opinion, that such a decision would have put in jeopardy the progress of the enterprize.

It was clearly the intention of the Legislature to confine the route to this State, unless it should be found there were urgent considerations for carrying some portions of it through Pennsylvania, and the Commissioners were, without exception, extremely desirous of confining the location to this State It was an unpleasant duty to carry the line into another State, that demanded compensation for the benefits that would be conferred on her citizens; while a portion of our own, that had contributed their exertions to secure its benefits, were thus deprived wholly, or in part, of the anticipated advantages. The law, however, under which this commission was established, contemplated the contingency of such decision. It was doubtless framed in view of the necessity that might be found to exist to abridge the benefits to a comparatively small number, in order to make it more beneficial to the public, and to secure the accomplishment of a great work that would confer its benefits on a large portion of the population of this State.

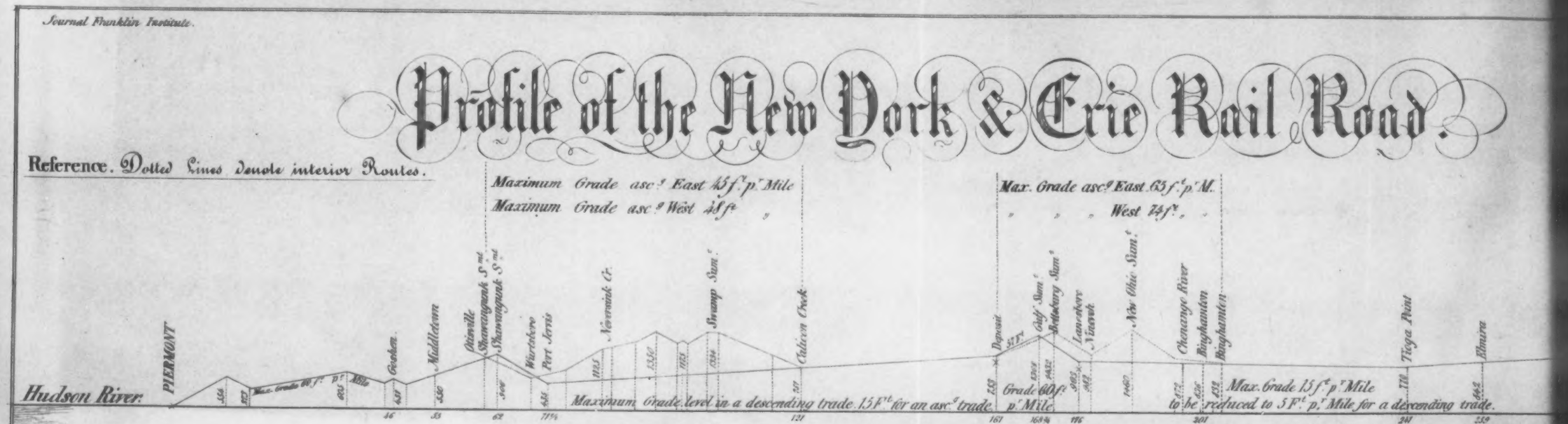
To illustrate the views of the Commissioners as to the influence the extra cost of conducting the traffic will have on the prosperity of the project, they remark:—

First.—It cannot be expected that an enterprize of this magnitude will be undertaken by private capital without a fair prospect of reasonable remuneration for the outlay required.

Second.—If the road be constructed in such a manner as to involve large expenses in conducting a given traffic, such expenses must be charged to those interested in the traffic, and, consequently, the value

Journal Franklin Institute.

Profile of the New York & Erie Rail Road.



Lith. of Wagner & M.c Guigan, 116, Chesnut St. Phila.

great efforts, continued for months together; and their final success may be attributed far more to the general influence the road was expected to produce on the trade of New York than to the dividends that would be made from its earnings.

The Commissioners can regard the law of 1845 in no other light than as emanating from a desire, on the part of the Legislature, to offer such further inducements to private capital as would be sufficient to secure the early accomplishment of this great improvement, and thereby afford to a large district of the State, now very much secluded, the means of easy communication to and from our great commercial centre. Subsequent events have proved that the inducements offered were barely sufficient to obtain the requisite subscription, upon which the new organization has been established. To show the slender hold the new subscription had on the stockholders, it is only necessary to mention that, before and at the time the decision of the Commissioners was made on the question of location, shares of stock, on which 20 dollars had been paid, could be purchased in the market for two dollars. In this state of the affairs of the Company, they were not in a condition to encounter difficulties which they regarded as onerous and unnecessary, and from which they had indulged the hope of being relieved. The Commissioners cannot say the work would have been abandoned if their decision had confined the line to this State; but, under the circumstances that existed, they were of the opinion, that such a decision would have put in jeopardy the progress of the enterprize.

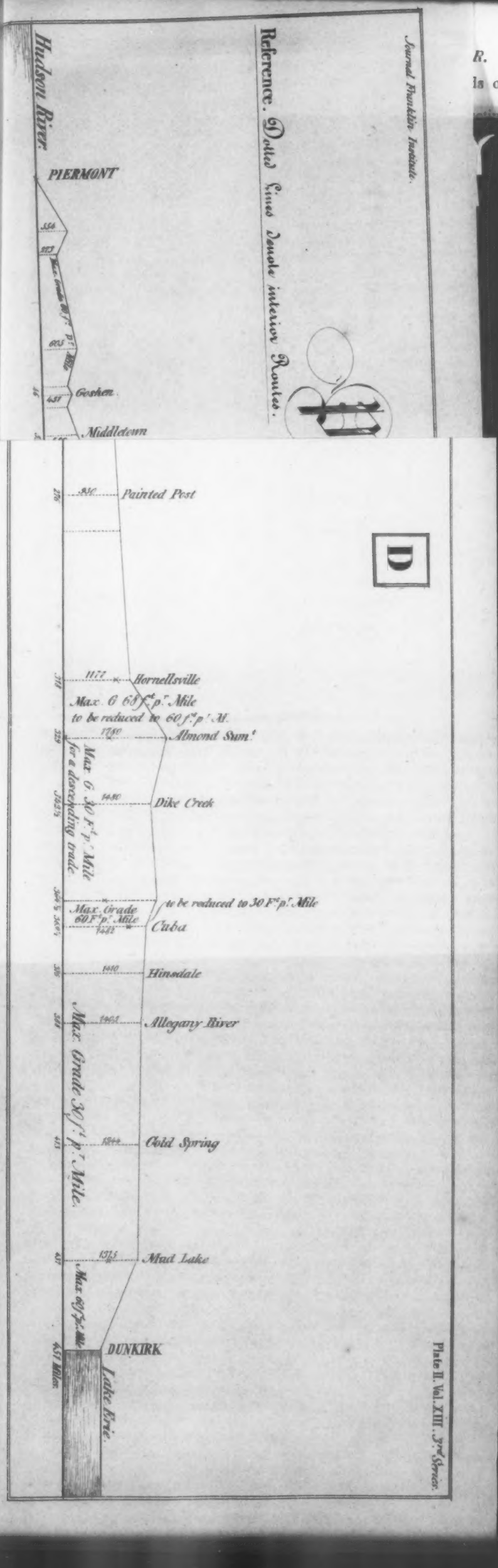
It was clearly the intention of the Legislature to confine the route to this State, unless it should be found there were urgent considerations for carrying some portions of it through Pennsylvania, and the Commissioners were, without exception, extremely desirous of confining the location to this State It was an unpleasant duty to carry the line into another State, that demanded compensation for the benefits that would be conferred on her citizens; while a portion of our own, that had contributed their exertions to secure its benefits, were thus deprived wholly, or in part, of the anticipated advantages. The law, however, under which this commission was established, contemplated the contingency of such decision. It was doubtless framed in view of the necessity that might be found to exist to abridge the benefits to a comparatively small number, in order to make it more beneficial to the public, and to secure the accomplishment of a great work that would confer its benefits on a large portion of the population of this State.

To illustrate the views of the Commissioners as to the influence the extra cost of conducting the traffic will have on the prosperity of the project, they remark:—

First.—It cannot be expected that an enterprize of this magnitude will be undertaken by private capital without a fair prospect of reasonable remuneration for the outlay required.

Second.—If the road be constructed in such a manner as to involve large expenses in conducting a given traffic, such expenses must be charged to those interested in the traffic, and, consequently, the value

Is on the


Journal Franklin Institute.
Reference. Dotted Lines denote inferior Routes.
Hudson River.
PIERMONT
556
923
Max. Grade 80 F.t p.r Mile
925
Goshen
44
451
Middletown
276
810
Painted Post
D
314
1177
Hornellsville
Max. G 68 F.t p.r Mile
to be reduced to 60 f.t p.r M.
329
1750
Almond Sum.t
Max. G. 30 F.t p.r Mile
for a descending trade.
382½
1430
Dike Creek
366½
Max. Grade
60 F.t p.r Mile
to be reduced to 30 F.t p.r Mile
360½
1411
Cuba
305
1410
Hinsdale
304
1401
Allegany River
Max. Grade 30 f.t p.r Mile.
413
1844
Cold Spring
407
1375
Mud Lake
Max 60 f.t p.r Mile
431 Miles.
DUNKIRK
Lake Erie.
Plate II. Vol. XIII. 3rd Series.

either route. Some portion will be less benefited by the adoption of one route than by the adoption of the other, and comparatively a very small number on either route may not be benefited at all, except the road be constructed on the particular route in which they may be interested. The latter can only be those who are so situated that they would only use the road in the event of its being constructed on the route nearest to them. The great mass of the citizens in the southern tier of counties must be benefited by the construction of the road on either of the proposed routes, and consequently are interested in such measures as will secure its early completion.

The total number of citizens residing on the routes affected by the question of location, or so near that their trade, after the construction of the railroad, would seek it as their avenue to market, is estimated by the census of 1845 at 294,599. Of this number, 45,592 will be less benefited by the adoption of the river routes than by the adoption of the interior routes, and 249,007 will be more benefited by the adoption of the river routes than by the adoption of the interior routes; or, the ratio is nearly as 16 is to 84. Of those who will be less benefited by the adoption of the river routes, about 72 per cent. will have the benefit of the river route on the Delaware, which will be common to them with citizens west of Binghampton, and will materially lessen their diminution of benefits. The amount of diminution of benefits, compared with equal population, appears on the average to be about the same, whichever route be adopted.

There is another portion of the citizens of this State who are directly interested in this question of location, namely: those resident in the city of New York.

This city has an interest in enlarging and securing the trade of the district that will be affected by the construction of the railroad, and it looks not only to that portion in this State, but also to that which will come from the northern part of Pennsylvania, (numbering about 100,000 people by the census of 1840,) and from Lake Erie. The citizens of New York city cannot be overlooked in considering this question, they are a portion of this State, and have an equal right to be considered under the Act, so far as their interests are involved; they are chargeable in all cases of State tax, in which they contribute about one-third of the total amount collected by the State. That their interest is peculiarly important in this enterprize is manifest from the fact, that almost the entire reliance, so far as individual means are required, must depend on them. Whatever risk of private capital the undertaking involves, must fall on them. The road may be a great benefit to the district through which it may be constructed, and yet afford a very inadequate return to the private capital invested in its construction. A due regard to this interest is not only important and proper in itself, but also as affecting the entire success of the project, as may be inferred from remarks in a preceding part of this report. The interest of the city of New York, whether regard be had to the benefit its trade will derive from the operation of the railroad, or the remuneration the traffic will afford for the capital invested in its construction, will be best promoted by the adoption of those routes that

will secure the best and most expeditious means of communication. This city, therefore, will be most benefitted by the adoption of the river routes.

The adoption of the river routes greatly improves the general prospects of the railroad, and presents very fair prospects for its early completion. The adoption of the interior routes would materially diminish its usefulness and value, if constructed, and, moreover, by the discouragement it would throw on the stockholders, would hazard the success of the enterprize. The latter remark cannot be regarded as unimportant, when it is considered that the new stock of the Company can now be purchased in the market at 20 per cent. discount, though only 25 per cent has yet been paid in.

In view of the facts that have been presented, and the reasoning based on those facts, after careful deliberation, in full Board, a majority of the Commissioners decided that the interior routes, through Sullivan and Broome counties, could not be adopted for that portion of the said railroad, "without great prejudice to the public interest of this State, and the interest of the citizens of this State who, in their judgment, will be affected by the construction and location of said railroad, collectively considered." And, in accordance with the requirements of the Act, they have filed such decision in the office of the Secretary of this State.

JOHN B. JERVIS,
HORATIO ALLEN,
JARED WILSON,
WILLIAM DEWEY.

French Railway Regulations.

The "Moniteur" contains a Royal ordinance issued on a report of the Minister of Public Works, fixing the general regulations that are henceforward to be observed by all railway companies in working their lines. The following are the principal points referred to:

The Way.—The stations are to be considered part of the public domain, and as such, to be regulated by the superior authorities. The entrance, the circulation, and the standing of public or private carriages, are to be subjected to the decisions of the Minister of Public Works. The repairs of the way, and of the works depending on it, though evidently at the discretion of the Companies, are to be made known to the Government authorities, who can interfere when anything is unsatisfactory. The crossings and passages on the line are to be subjected to Government regulations, particularly in what relates to the barriers required for the latter. High embankments, viaducts, and bridges over rivers and streams, are to be defended by strong parapets. All stations, passages on the level, &c., are to be well lit up.

The Working Stock.—Locomotives are, in the first instance, to be subjected to certain proofs of strength, for the boilers, axletrees, wheels, &c. They are to be provided with an apparatus to catch the pieces

of coke falling from the furnace, so as to prevent their reaching the ground. Every means must also be employed to prevent sparks from issuing from the funnel, whereby property along the line has from time to time been set on fire and consumed. The report regrets that the grating at present in use is not found to be efficient. Axletrees are in all cases to be made of wrought iron, of the first quality.

Composition of Trains.—All Companies are bound to furnish a sufficient number of carriages of every description to supply the wants of each station. The hours fixed by the Company for departure are to be rigorously observed. As the public, in a great measure, are dependent on railways for their mode of transport, these two regulations are absolute on all Companies whatever; when any exception to this rule is permitted, as in the case of direct trains, it is the Government authorities who must regulate the matter. In case of *fete*, or extraordinary movement from one point to another, the Company is obliged to provide an additional and sufficient number of carriages of every class; the number of carriages for a single train is not to exceed 24, and this is to be considered rather as the exception than the rule. Double locomotives are permitted, as otherwise trains would be multiplied to a dangerous extent. But whenever the second locomotive is employed, the cause of such proceeding must be entered in a book kept for the purpose. No matters liable to explosion are to be transported in a train in which passengers are carried. A means of communication must always be established between the conductor and the engine-driver.

Departure, Circulation, and Arrival of Trains.—A number of articles refer to the measures of precaution to be used in starting trains at proper hours, so as to leave a sufficient time between each; the maximum of speed; the precautions to be taken in passing through tunnels, &c. They also regulate the passage of extraordinary trains, the obligation of communication by signals, and the general superintendence of the line. Registers are to be kept at every station for marking down the causes of all delays. No train is ever to leave before the hour appointed in the printed lists.

Fares.—The conditions of the concession generally regulate the tariffs; but a Company may lower its prices if it thinks fit, subject, however, to the condition of keeping them so, for a certain time. As a general rule however, no changes whatever can be made by the Company without first submitting them to the Government authorities. Railways that have been conceded prior to 1835 will not be subject to these regulations until April 1, 1847. Equality of charge is to be strictly enforced, as otherwise the Companies would become unjust to one locality at the expense of another.

Regulations relating to Passengers.—All persons unconnected with the Company and the service are forbidden to enter the premises of a railway without permission, or to there stand or circulate, or to place there objects of any kind, or to introduce horses, dogs, or other animals, or to cause vehicles of any kind to circulate there. Government authorities are an exception to this clause. Passengers are not to lean out of carriages, or pass from one to another, or carry loaded

fire-arms, or leave a carriage when in movement. The other prescriptions are generally similar to those in force for common carriages.

General Arrangements.—No person can sell anything within the precincts of a station without permission from the authorities. When a line crosses several departments, the attributions conferred by the present regulations on the several Prefects may be concentrated in one. Every person employed by a Railway Company must wear a uniform, in order that the public may at once see, in case of need, to whom they are to apply. *Signal-men, guards, and barrier-keepers* may wear *a sabre.* At each station a book must be kept to receive the complaints of passengers. Copies of the present regulations are to be constantly kept placarded in all stations; copies are also to be given to each person employed, and whatever relates to passengers is to be hung up in each carriage.

Lond. Railway Mag.

Menai Tubular Bridge.—Experiments at Blackwall.

We have on one or two recent occasions witnessed experiments made on the huge model of the proposed tubular bridges of the Chester and Holyhead railway, under the able direction of Messrs. Hodgkinson and Fairbairn, when several other eminent engineers were present. The principal object of the present experiments has been to ascertain the proper proportions of the sectional areas of the top and bottom of the tube. Great additional strength has been obtained by stiffening the side plates with vertical ribs of T iron, attached at equal intervals throughout the whole length of the tube.

In the first experiments, the sectional area of the bottom plate being 22½ square inches, of the top 24 square inches, and the sides 10 inches, a weight of 58 tons produced a deflexion of 3·2 inches. This weight was allowed to remain till the following morning, and the increase of deflexion was found to be inconsiderable. The tube being subsequently laid on its side, in order to test its lateral strength, it was fonnd that 9 tons produced 2 inches deflexion, and 12 tons, the last load laid on the tube in that position, produced 3⅝ inches total deflexion, including that due to the weight of the beam itself.

In the concluding experiments, Dec. 23, it was determined to load the model bridge till it was broken. The following table exhibits the deflection corresponding to each load:—

Experiments.	Load.	Deflexion.
No. 1,	31,612 lb.	0·70 inches.
2,	57,947	1·31
3,	83,310	1·91
4,	105,362	2·38
5,	117,326	2·77
6,	125,927	2·96
7,	135,255	3·17
8,	Same weight after remaining 9 days	3·22
9,	139,567	3·38

Experiments.	Load.	Deflexion.
10, - -	144,352 - -	3·48
11, -	149,684 -	3·70
12, - -	151,772 - -	3·81

With the last load, equal to 67¾ tons, the beam broke.

In order to a right apprehension of the manner in which the fracture took place, it must be understood that the thickness of the bottom plate had been greatly increased near the middle point of the model by additional plates, which were continued for 20 feet on each side of the centre; and it was where the thin part, or single thickness of the bottom plate, commenced, that fracture took place. The bottom plate was torn asunder with a very irregular line of fracture, not contiguous to the rivets. The vertical or side plates also gave way, but in them, the rivets (24 on each side, of $\frac{5}{16}$ iron) were actually cut or sheared asunder, the rivet-holes being uninjured. The top or cellular plate remained perfect.

These experiments have suggested several improvements of details in the bridges to be constructed over the Menai and Conway: but at present the modifications are not defined sufficiently to be laid before the public. The utmost precautions have been taken to secure the strength and stability of the proposed structures. The greatest credit is due to the skill and perseverance displayed by Messrs. Fairbairn and Hodgkinson, and other gentlemen called in by Mr. Stephenson to carry on the investigation, and also to the liberality with which expensive models have been provided. Civ. Eng. & Arch. Jour.

An Extract from an Historical and Geographical Examination of the Isthmus of Panama: The different directions in which it may be cut, and the means to be employed. By Michel Chevalier. *Paris, published by Charles Gosselin, 30 Rue Jacob,* 1844.

Translated for the Journal of the Franklin Institute, by Persifor Frazer, Esq.

Nicaragua Route.

Measured from shore to shore, at the port of San Juan de Nicaragua, the distance between the two oceans is 150 kilometres; (93·25 miles;) obliquely from San Juan de Nicaragua to San Juan of the South, it is 250 kilometres; (155·50 miles;) and from the same point to Realejo, more than 400 kilometres; (about 250 miles;) all in a straight line. But a great convulsion of nature has opened in the midst of the land the bed of a spacious lake, that of Nicaragua, an inexhaustible reservoir, which, by the wide and deep river San Juan, empties itself into the Atlantic, and seems a prolongation of that ocean into the interior of the continent. The two seas thus approach each other very nearly, and two bays, that of Papagayo and that of Nicoya, indent the shore of the Pacific as though that ocean would, in its turn, assist in opening the communication. Beyond the river and the lake, the

traveler coming from the Atlantic arrives at another lake, that of Leon, (or Mauagua,) terminated to the north by a sort of crescent, whose extreme north west point (that on which was formerly situated the town of Leon, now transported into the interior, and where is now the port of Moabita) is nearer to the Pacific than any point of lake Nicaragua, as the distance thence to the port of Tamarindo is but 14 or 15 kilometres; (about 9 miles;) this last lake discharges itself into the former by the river Tipitapa. Finally, on the coast of the Pacific, near the lake of Leon, is the port of Realejo, of which it was formerly said, that it was "excelled by none within the dominions of Spain." These fine lakes and noble rivers communicating with each other, remind us of those situated in Scotland, in a gorge between the two seas washing the shores of Great Britain, by the aid of which, a canal sufficiently spacious to receive frigates has been opened. In the same manner, they invite man to open from sea to sea a communication whose importance to the general commerce of the world will be to that of the Caledonian canal about in the same proportion as that which a strait holds to the great ocean, or the island of Great Britain to the continent of the two Americas.

The lake of Nicaragua is 176 kilometres (109·50 miles) in length, 55 (34 miles) in width, and nearly throughout has a depth of 25 metres. (82 feet.) The river San Juan, which, running to the eastward, is a prolongation of the great axis of the lake, has a course of 146 kilometres. (91 miles.) The lake of Leon has for its greater length 63 kilometres, (39 miles,) and a circumference of 147. (91·50 miles.) The river Tipitapa, by which it empties itself into lake Nicaragua, is 55 kilometres (34·25 miles) long. Thus, there is, from the Atlantic to the head of lake Nicaragua, a distance of 322 kilometres, (202 miles,) and to the head of lake Leon 440. (273·50 miles.) The town of Leon, situated 25 kilometres (15·50 miles) from the lake of the same name, is the most populous city of the neighborhood of lake Nicaragua, and, with the exception of Guatemala, of all Central America.

Here the junction of the oceans may be attempted in several directions. 1st. The line may be carried from the city of Nicaragua, on the lake of the same name, to the port of San Juan of the South, on the gulf of Papagayo. 2d. From the same lake to the gulf of Nicoya, also called the bay of Caldera, there is reason to believe that there are facilities for the construction of a canal, by means of the river Tampisque, which empties into that gulf, and by the Sapua, which flows into the lake to the south of Nicaragua. These two rivers, each having an abundant provision of water, approach each other very nearly in the vicinity of the bay of Las Salinas, an arm of the gulf of Papagayo. 3rd and 4th. From the north-west point of the lake of Leon, a communication may be practicable either to the port of Tamarindo, or to that of Realejo. 5th. A line has also been mentioned from the same point to the river Tosta, which is crossed on the route to Realejo, and which descends from the volcano of Telica. 6th. Finally, perhaps a junction may be possible from the north east point of the lake of Leon to the bay of Couchagua. This done, there would remain to be carried into effect, the improvement of the

navigation of the river San Juan de Nicaragua, and, in case the route should be through lake Leon, that of the Tipitapa, so as to render them navigable for large vessels. The river San Juan is navigated on its entire length, and during the whole of the year, by pirogues drawing from 1 to 1·20 metres (3 to 4 feet) of water; but, nearly throughout, its depth is much greater. By the improvement of four or five rapids and shoals* which are met with here and there, it would be easy for ships drawing from 3·5 to 4 metres (11 to 13 feet) of water to pass from the sea to the lake. The river being in most places enclosed betwixt banks of a slight elevation, the necessary works would be reduced to a few dams, each of which would be accompanied by a lock. The bar of the river San Juan has on it a depth of 3·5 metres, (11·50 feet,) and there is, according to Mr. Robinson, a narrow pass across it, with a depth of water of 7·5 metres. (23·50 feet.)

The port of San Juan, situated at the mouth, is safe and spacious. Numerous reports of naval officers who have recently visited it, represent it as excellent.† Its salubrity, a very rare advantage along the Atlantic shore of Central America, is generally acknowledged. The

* According to the information communicated to Mr. Stephens, by Mr. Bailey, the state of the river and the distribution of the rapids is as follows: From the lake to the river Des Savalos, a distance of about 33 kilometres, (20·50 miles,) the depth of the San Juan varies from 3·65 to 7·30 metres. (12 to 24 feet.) Then commence the rapids of El Toro, which are 1850 metres (2023 yards) in length, and have a depth of water from 2·75 to 3·65 metres. (9 to 12 feet.) For an interval of 7400 metres, (8100 yards,) we find an easy navigation, but on arriving at Cartillo Viejo, we meet with another rapid which has a length of about 1000 metres, (1100 yards,) and from 3·65 to 7·30 metres (12 to 24 feet) depth of water. After a space of 3700 metres (4046 yards) of good navigation, with from 4 to 4·50 metres (13 to 15 feet) of water, we arrive at the rapids of Mico and Las Balas, which succeed each other, and have, together, a length of 1850 metres; (2023 yards;) the depth of the channel varies from 1·83 to 5·50 metres. (6 to 18 feet.) After another navigable space of 2800 metres, (3062 yards,) come the rapids of Machuca, 1850 metres (2023 yards) long; these are the most dangerous of all, for the river here runs over a bed covered with pointed rocks. To these succeed a natural basin, 18·50 kilometres (11·50 miles) in length, with from 3·65 to 13 metres (12 to 42 feet) of water, which brings us to the junction of the San Carlos. 20 kilometres (12·50 miles) further, the San Juan receives the Sarapiqui, the only communication between the State of Costa Rica and the port of San Juan on the sea. Along this passage some islands are scattered, and the depth is from 1·83 to 11 metres; (6 to 36 feet;) the shallowest points being at the bends of the river, where the mud and gravel have accumulated. Finally, after a further course of 13 kilometres, (8 miles,) we arrive at the separation of the Colorado. Thence to the sea the distance is 24 kilometres, (15 miles,) which may easily be reduced to 18·50. (11·50 miles.) All the soundings given here were taken at low water. It may be remarked that, according to this statement, the length of the river is 129 kilometres, (about 80 miles,) instead of 146, (91 miles,) as mentioned at another place by Mr. Stephens.

The dams to be constructed at each of the 4 rapids will be from 80 to 100 metres (87 to 110 yards) in length. Dredging will be required at some other points.

† The opinion of Mr. Bailey, as given by Mr. Stephens, is that the port is *unexceptionable, but small.* All our other informants agree in recognizing it as of considerable extent. Messrs. Rouhaud and Dumartray say, that "it is *vast, and altogether safe*, which can be said of no other point on the eastern coast of Central America." Some scientific officers of the French navy, who were instructed to examine it in 1843, say, expressly, that it is a *vast and safe shelter, (un asile vaste et sur,)* a beautiful situation, an excellent port, and, they add, a good anchorage close to the land.

trade winds, whose action is not broken by any continuous chain of mountains, sweep away the miasmas which rise in abundance from the neighboring marshes, so completely as to prevent the ravages of the yellow fever. It may possibly not always be so, should a numerous European population be established there. In Central America, the same reproach is made against San Juan de Nicaragua as that made in France against Brest—that it is rainy *par excellence*. In this respect, there is a great difference betwixt San Juan and the port of San Carlos, situated on the lake, at the point where the river escapes from it, and still more so betwixt San Juan and the cities of Grenada, Nicaragua, and Leon, which enjoy a sky always serene; this is, however, an inconvenience which requires nothing more than a passing notice.

We may admit then that the river San Juan terminates at a good port, and that its navigation may easily be improved so as to render it practicable for sea-going vessels drawing, as we have already said, from 3 to 4 metres (10 to 13 feet) of water. As regards this, the past will answer for the future. Tradition assures us that, formerly, sea-going vessels ascended the river San Juan, and, that at the great annual fairs held at Grenada, at the bottom of lake Nicaragua, several brigs, or three-masted vessels, arrived regularly from Cadiz, or other ports of the peninsula, after having touched at Carthagena, or Porto Bello. I am not referring here to one of those false traditions which delight in representing men and things as ceaselessly degenerating. Mr. Rouhaud has verified the fact in the archives of the city of Grenada. He found there evidence that, in the middle of the 17th century, three-masted vessels *(fragatas)* of the Spanish commercial marine frequented the anchorage of *las Isletas*, which is, on the lake, the port of the city of Grenada; and I have seen in his hands original papers going back as far as 1647 and 1648, which prove it. But in 1685, the river underwent a great change, produced by the hands of man. A new channel was forcibly opened, by which, under the name of the Rio Colorado, a considerable portion of its waters escaped. According to the soundings made by Mr. Bailey, as given by Mr. Stephens, the Colorado, when its waters are low, discharges 360 cubic metres (about 471 cubic yards) per second. This is three times the volume of the Seine at Paris, at its lowest stage. When its waters are high, the Colorado discharges 1095 cubic metres (1432·25 cubic yards) per second. Since 1685, the ancient bed of the river, below the point at which the Colorado separates from it, cannot receive boats drawing more than from 1 to 1·20 metres (3 to 4 feet) of water. The Colorado itself is inaccessible to merchantmen, on account of a bar at its mouth which they cannot cross.

It was war, the cause of so many difficulties in the world, that occasioned this revolution in the river San Juan. The Caribbean sea and its vicinity was then infested by buccaneers, who carried every where with them devastation and pillage, with a courage and audacity that one regrets to see in the service of the brutal passions. These robbers laid waste all the Spanish establishments bordering on the sea. To prevent them from penetrating to the lake of Nicaragua, the in-

habitants sunk hulls of ships, rafts loaded with stone, and whatever else they could lay their hands on, about 20 kilometres (6·50 miles) above the mouth of the river. The rainy season having arrived, the river, which at that time brings down a great number of trees, uprooted by the current from its banks, increased the obstruction, the sands accumulated, and very soon it became a dyke which arrested the course of the waters. They then sought another channel, and thus the Colorado was formed. When the freebooters were no longer to be feared, an attempt was made to re-open the ancient bed; but it was done in the inefficient manner which too often characterizes a Spanish administration, and the only means which could have succeeded, a dam across the entrance of the Colorado, were not employed. By such a dam, 410 metres (448 yards) in length, which may be constructed as well now as then, and by the improvement of the ancient channel, the river may be made to resume its primitive course and state.

The inconsiderable works which we have summarily indicated for the rapids and reefs of the river above the Colorado, would suffice to render the San Juan de Nicaragua constantly navigable with safety for vessels drawing from 3·50 to 4 metres (11·50 to 13 feet) of water. But this would not be sufficient for such a junction of the two oceans as would be desirable at the present day. Much more extensive works would be necessary to place the river in a state to afford a passage to ships such as those received in the Northern canal of Scotland, and in the Caledonian canal, and such vessels as the transatlantic packets. To attain this end, it might possibly be necessary to renounce all idea of a navigation in the bed of the river for a great portion of its course, and to excavate a lateral canal. The ground is favorable for so doing, but by reason of the dimensions of the cut, the expense would be great; Mr. Stephens estimates it, probably from Mr. Bailey's observations, and in adopting a series of prices about the mean of those of the United States, at 10 or 12 millions of dollars. That is about one-half of the sum which would be required, according to his calculations, to establish the communication between the two oceans from the port of San Juan de Nicaragua to San Juan of the South.

The Tipitapa offers facilities even greater than those of the San Juan de Nicaragua. It appears generally to be closed in like a canal; there would be but about 50 metres (55 yards) of dam to be constructed. In a length of 55 kilometres, (34·17 miles,) it has a fall of 8·74 metres. (28 feet 8 inches.) The half of this fall is at one spot, the town of Tipitapa, near the lake of Leon, where there is a cascade of 4 metres. (13 feet.)* M. Rouhaud has expressed himself, in reference to the site of this town, in terms of the liveliest enthusiasm. He repre-

*According to Mr. Stephens, the whole of the fall of the Tipitapa, amounting to 8·74 metres, (28·67 feet,) is comprised in the first 10 kilometres (6·25 miles) below lake Leon; M. Rouhaud, who took a part in the topographical operations executed in the country, has told me that the fall of 8·74 metres (28 feet 8 inches) is divided as follows: 5·49 metres (18 feet) in one fall at Tipitapa, and the remaining 3·25 metres (10 feet 8 inches) between Tipitapa and lake Nicaragua.

sents it as one of the best possible localities for a great city; a plain—yielding in abundance, at the same time, products the most valuable and the most usual, indigo of the finest quality, and maize in the ratio of 400 to 600 grains for one, spreads out here to a great extent. The town is placed *(à cheval)* between the two lakes, one may almost say, between the two seas, and the fall of the river furnishes an inexhaustible water-power for manufacturing purposes. But when will human industry display its miracles of activity in this enchanting spot? Will it ever establish here its residence and fix its empire? Mr. Stephens, proud as he is of the prowess, in matters of industry, of the Anglo-Saxon race in general, and of his countrymen, the North Americans, in particular, when he found himself beneath this dazzling sky, in presence of the limpid waters and graceful shores of the lake, surrounded by this prolific nature, offering in profusion all the necessaries of life, when he felt himself bathed by this soft air, which inclines the soul to reveries and the body to repose, he despaired even of the restless energy of the Anglo-Americans, and expressed a doubt whether those intrepid champions of industry, transplanted to such a home, would be able to resist its seductions, nor abandon themselves to the idleness they despise. Neither does the necessity of crossing lake Nicaragua appear to be an objection to this route, although it has been said to be liable to sudden squalls of great violence; decked vessels would be in no danger from them. They would be *perfectly* safe if towed by steamers, the same which had brought them up the river San Juan, and the towing across the lake would naturally be effected with a very trifling addition to the expense; in return for which, there would be an economy of time.

It remains to ascertain what difficulties are offered by the barrier to be surmounted between lakes Nicaragua or Leon, and the Pacific.

There is no country so covered with volcanoes as is this part of America between the 11th and 13th degrees of north latitude; but on the right of lake Nicaragua, the mountains, by whose craters the subterranean fire finds a passage, are in small isolated groups, and sometimes in solitary peaks; they spring up from the plain, leaving between them valleys, or at least passages. This narrow tongue of land which separates lake Nicaragua from the Pacific, strewed, as it is, with gigantic peaks, affords at their base a surface of no great elevation. The accounts of the celebrated navigator Dampier, who fought in these regions, lead us to believe that along the different routes from lake Leon to Realejo, and from lake Nicaragua to the gulf of Papagayo, or to that of Nicoya, the ground is generally even and in savannahs, and that between lake Leon and the coast of Realejo, the natural soil is altogether flat. Mr. Stephens also, speaking of his personal impression, says, that the soil is perfectly level. M. Rouhaud has spoken to me in the same terms of the space comprised between the north-west point of lake Leon and the port of Realejo; and of the ground extending from the same point of the lake and the port of Tamarindo. He estimates at 6 or 7 metres (20 or 23 feet) the height of the bank above the surface of the water; then comes, he says, a little zone, perceptibly level, and thence you descend gently towards the Pacific

ocean. This unanimity of opinion is encouraging; nevertheless it is not sufficient to dispense with the necessity of an exact leveling; without this, there can be no certainty. The eye of even an experienced observer appreciates with difficulty the rise of ground when the ascent is gradual. Mr. Humboldt says "nothing is more deceiving than the judgment one forms of the difference of level on a prolonged, and consequently gentle, slope. In Peru, I could hardly believe my eyes on finding, by means of a barometric observation, that the city of Lima is 91 toises higher than the port of Callao." The mango-trees *(mangliers)* that Dampier saw on the route from Realejo to Leon, are a certain index of a low and humid soil; but he does not say that he observed them along the whole line.

Of the various lines above mentioned, one alone has been examined by geometrical observations.

(To be continued.)

AMERICAN PATENTS.

List of American Patents which issued in the month of April, 1846,—with Exemplifications, by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For *Improvements in Cutting Screws on Bedsteads, &c.;* Hezekiah P. Nuckols, Glasgow, Kentucky, April 4.

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is the combination of the right and left-hand screw cutters with the frame for tapping and boring, substantially in the manner set forth, so that they can be brought into action or removed at any required time, as described, and designate the proper angle for the frame."

2. For an *Improvement in the Gate for Railroads;* David Percival, Middletown, Delaware, April 4.

The gate is so constructed as to slide vertically, and is connected with inclined beams on the side of the rails, which, when depressed by the passage of a car over them, depress the gate, and then permit it to rise when the car has passed.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combination of a balance gate with a railroad track, by means of the vibrating beams, combined, constructed, and operating with the same substantially in the manner and for the purpose set forth."

3. For an *Improvement in Sulkey Carriages;* J. R. Remington, Lowndes county, Alabama, April 4.

This is a one-wheeled carriage, the shafts of which are so constructed

and connected with the harness on the horse as to balance it on the one wheel and prevent it from upsetting.

Claim.—"Having thus fully described my improvement and its operation, what I claim therein as new, and desire to secure by letters patent, is constructing the shafts of a one-wheeled carriage, and connecting them with the horse, substantially in the manner and for the purpose set forth."

---

4. For an *Improvement in the Filtering Cock;* Thomas F. Wenman, New York city, New York, April 4.

The valve of this cock is a hollow cone divided into two chambers by a filtering partition, so that the liquid in passing through shall be filtered.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the filter within the inner cone of the cock, by means of a groove made in the inner cone; also, on the bottom plate placing the two perforated plates, with the filtering substance between them, so that all the water, or other liquid fluid, has to pass through the plates and filtering substance above named, substantially in the manner and for the purpose described."

---

5. For an *Improvement in the Method of Constructing Trunks;* James Hibson, New York city, New York, April 4.

The patentee says,—"My improvement is confined to the skeleton, or frame-work, of traveling and other trunks, and to the mode of connecting thereto the exterior covering. Instead of constructing the ribs (which constitute the skeleton of such trunks,) of wood or metal, I use strips of whalebone, which, by its elasticity, preserves the original shape of a trunk after the latter has been subjected to wet or accidental pressure. These strips, when bent to the required form, are secured to the iron lips of the trunk by having their ends inserted into sockets formed of sheet metal, and riveted to the lips. The lips are united at one side, by metallic or other hinges, in the usual manner. To connect the outer, or leather, covering to the skeleton, I use small clamps, made of thin sheet metal."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the whalebone ribs, and the mode of combining them with the frame-work of the trunk."

---

6. For a *Process for Purifying or Cleaning Whale Oil;* Patrick Fitzsimmons, West Troy, New York, April 4.

For the purpose of precipitating the gelatine and albumen, finely pulverized alum is mixed with the oil. The proportion of alum for a hundred gallons of oil is from fifteen to twenty-five pounds, according to the quality of the oil.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of separating the impurities from whale

and other animal oils by means of alum, under the treatment substantially as herein described."

---

7. For an *Improvement in the Filtering Stop-cock;* Jonathan F. Ostrander, New York city, New York, April 4.

Claim.—"I do not claim the placing of a filter in the plug or core of a stop-cock; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the filtering core with the auxiliary passage, for allowing an unobstructed flow of the water, substantially as herein described."

---

8. For an *Improvement in Propellers for Steam Vessels;* Bennet Woodcroft, Manchester, England, April 4, 1846, antedated February 13, 1844.

This is for an improvement in that class of propellers in which the shaft is parallel with the keel, and the vanes or paddles, segments of a helix; and the improvement claimed consists in connecting the vanes with the hub on the main shaft by an arber, to admit of turning, that their obliquity may be varied by the sliding of a box on the shaft connected with the arbers of the vanes by means of arms projecting therefrom, and jointed to the sliding box.

Claim.—"Having now described the nature of my said invention, and the manner in which I carry it into effect, I declare that I do not claim any of the parts separately which I have used in my improvements in propelling vessels; but I do claim as my invention the combination of the blades of propellers, such as I have shown and described, with an apparatus for setting the same, arranged and operating substantially as herein set forth; the sliding box with oblique grooves being made to operate upon arms which are attached to the shafts upon which the propellers are to turn, said sliding-box being made to move back and forth on the propeller shaft by the turning of a rod, or by any other equivalent means."

---

9. For *an Improvement in Printing Presses;* Alva B. Taylor, New York City, New York, April 4.

To avoid the shock and jar at the end of each reciprocating motion of the carriage of the Napier press, particularly when it is attempted to operate the press with considerable velocity, air cushions or springs are used, and made by having a piston or pistons attached to the ends of the carriage, so as to compress air in cylinders attached to the frame. These pistons either enter short cylinders at the end of the motions of the carriage, or the cylinders have apertures near the end, so that the pistons are only resisted by the compression of the air towards the end of the motions of the carriage.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of arresting the momentum of the carriage which carries the form of types in printing

presses by means of plungers, that compress air in cylinders only towards the end of the motion of the carriage, as herein described."

---

10. For an *Improvement in the Self-Acting Register for Stoves;* Washburn Race, Seneca Falls, New York, April 4.

An expansion rod is connected at its lower end by a knife edge with a lever which is in turn connected with the register, so that as the rod contracts by the reduction of temperature the register is opened, and vice versa.

Claim.—"Having thus fully described the construction and operation of my improved self-acting register for stoves, or close fireplaces, what I claim therein as new, and desire to secure by letters patent, is the manner in which I combine the expansion rod, with the register or valve, by means of the lever, the whole constructed and operating in the manner and for the purpose herein set forth, or in any manner substantially the same, by which the ordinary connecting joints are avoided."

---

11. For an *Improvement in Horse Rakes;* Lorin M. Whitman Pike, Allegheny county, New York, April 4.

On the rotating head of the rake and near each end, there is a segment of a wheel with which the head turns that the teeth may be discharged when full, and these segments of wheels are so combined with a stop bar and catches on the frame, as to arrest the head at the required portion of its revolution.

Claim.—"I hereby disclaim the original invention of horse hay-rakes, as heretofore constructed and used. I likewise disclaim the invention of the plan of attaching the lower ends of the handles by a strap of iron passing around the head of the rake.

1st. What I do claim, and desire to secure letters patent for, is the invention and combination of the segments of wheels with the head of the rake, and by which it revolves in the manner substantially set forth in the specification.

2d. I claim the combination of the stop bar and catches with the segments of wheels, to hold the head of the rake in a straight position for raking. And I do hereby further declare that I do not intend to limit myself to the precise size or form of the segments of wheels on which the rake revolves, nor to the shape, size, or length of the head or other parts of the said rake; but I wish to vary the same as I may think expedient, so as to admit of the application of a set of double teeth to the head of the rake on the same principle on which the single tooth is applied, whilst I attain the same ends by means substantially the same; that is, in producing a revolving spring tooth, horse hay-rake, with a stop bar and segments of wheels to revolve on, &c."

12. For a *Machine for Washing and Rinsing Cloth in Calico Printing;* George I. Prentiss, Tiverton, Rhode Island, April 4.

We are under the necessity of omitting the claim in this case, as it refers to, and is wholly dependent on, the drawings.

---

13. For an *Improvement in Propellers for Vessels;* Daniel Deshon, 2nd, New London, Connecticut, April 4.

The paddles are hung by journals to the arms of the wheel that they may turn therein, and to the journals there is an arm extending to the same distance on either side of the axis of, and parallel with, the plane of the paddle, and these arms are provided with wrists that are acted upon by a series of circular projections on the rim of the wheel for the purpose of turning the paddles that they may present their surface to the water at the point of maximum propulsion, and feather when passing through that portion of their circuit in which they are not required to propel the boat.

Claim.—"Having thus fully described my improvements, what I desire to secure by letters patent, is the method of turning the paddles, as herein described, by means of a revolving ring having guiding projections thereon, around which the wrists on the arms of the paddles play in the manner and for the purpose set forth."

---

14. For an *Improvement in Railroad Wheels;* Thomas Glasco, Wilmington, Delaware, April 4.

This is for a mode of fastening the treads or tyres of railroad wheels to the main rim, or "centre" as it is termed in the specification before us. The outer periphery of the "centre" is made conical to fit the correspondingly formed inner periphery of the tread, and the outer periphery of the "centre' or inner rim is grooved to receive a ring cut in three parts, so that when the outer rim or tread is slipped on, by means of radial screws, the segments of the ring can be forced into a groove in the inner periphery of the outer rim; one face of the segment ring being beveled so that, when forced out, they (the segments) shall act as wedges to force the outer on to the inner rim.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of connecting the centre with the rim by the circular wedge, which is divided into three parts, and fastening the same by the screws, as described in the specification."

---

15. For a *Machine for Moulding Bricks;* Joel L. Ransom, Millport, New York, April 4.

We are under the necessity of omitting the claim of this patent because of its reference to, and dependence on, the drawings. The machine is for moulding bricks of tempered clay.

16. For a *Churn;* Charles King, Scipio, Cayuga county, New York, April 4.

There is a vertical dasher which by means of a handle can be made to move up and down, and through slots in this pass the arbers of two vibrating dashers which have their bearing in the wash box, and these are made to strike the clothes placed between them and the vertical dasher, by having the vibrating dashers connected with the vertically sliding one, so that as the one is moved up and down the other shall alternately strike the side of the vertical dasher.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the vertical dasher with the oscillating dashers, constructed and operating in the manner and for the purpose herein set forth."

---

17. For an *Improvement in the Spring Lancet;* Jacob H. Gemrig, Philadelphia, Pennsylvania, April 11.

The Lancet is formed at the end of a slide that works in a case, the metal slide having a stem that passes through the case to receive a helical spring by which the Lancet is forced out, and the case being provided with a spring catch to hold when drawn back into the case. The whole is put into a case somewhat similar to a pencil case.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the several parts of the instrument, viz: the blade and the sliding frame, the spring catch, and the spiral spring; and, in combination therewith, the mode herein set forth of regulating the length of the stroke of the blade."

---

18. For *Improvements in the Brick Press;* Thomas Hartly, Pittsburg, Pennsylvania, April 11.

The machine for reducing the clay consists of two toothed cylinders, the teeth of which play into each other and between the bars of a grate, and after the clay is delivered from these it is acted upon by another toothed cylinder, the teeth of which play between the teeth of a concave. The moulds are formed in a rotating platform, and the bricks are pressed from above and below, the upper followers not being permitted to descend into the moulds.

Claim.—"Having thus fully described my improved brick machine, what I claim as my invention, and desire to secure by letters patent, is the combination of the rollers, adjustable grate, and concave, for grinding mortar, substantially in the manner and for the purpose described.

"I also claim the combination of the revolving moulds and pressing apparatus, pressing the brick on both sides, the upper follower not entering the mould, as herein described, by which a perfect brick is made, sufficiently pressed on both sides; and great rapidity of operation is secured, substantially in the manner above made known."

19. For *Improvements in the Combination Lock;* Joshua H. Butterworth, Dover, New Jersey, April 11.

The following claim will enable the reader, if acquainted with the principle on which combination locks operate, to understand fully the nature of the improvements patented.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the arrangement of the circular plates, for elevating the tumblers into notches in the main bolt, and raising and lowering the levers, which act upon the movable talon, in combination with the movable talon and the preventive stop or flying tumbler; all as herein set forth."

---

20. For a *Magnetic Telegraph;* Samuel F. B. Morse, New York city, New York, April 11.

Claim.—"What I do claim as my invention, and desire to secure by letters patent, is the receiving magnet, or a magnet having a similar character, that sustains such a relation to the register magnet, or other magnetic contrivances for registering, and the length of current or telegraphic line, as will enable me to accomplish, with the aid of a main galvanic battery and the intervention of a local battery, such motion or power for registering as could not be obtained otherwise without the use of a much larger galvanic battery.

"I claim as my invention the use of a local battery and magnet, in combination with a battery and magnet connected with the line or lines of conductors, for the purpose above specified.

"I also claim the combination of the apparatus connected with the clockwork for setting off the paper, and stopping it with the pen lever.

"I also claim the combination of the points affixed to the pen lever with the grooved roller for marking on paper, as above described."

---

21. For an *Improvement in the Lamp for Light Houses;* Charles Wheeler, Rockport, Massachusetts, April 11.

The object of this improvement is to avoid the necessity of using a stove in light houses during the winter to prevent the condensation of vapor on the glass.

A small auxiliary lamp is placed below the reservoir of oil which supplies the light house lamps, and from this auxiliary lamp a small tube passes up through the reservoir of oil.

Claim.—"I do not claim merely the use of an auxiliary lamp for keeping the oil fluid in cold weather, but I do claim the arrangement of said lamp, and its heating tubes, in combination with the above described apparatus or system of light-house lamps, substantially in the manner and for the purpose set forth in the foregoing specification."

22. For *Improvements in Leather Belts for Driving Machinery, and in the Machinery for making them;* William Kumbel, New York, April 11.

Claim.—"What I claim as my invention is the method of making leather bands by stretching the pieces separately, when this is combined with the stretching of the whole after the pieces are put together, as described. And what I claim as my own invention, in the above-described machine, is the combination of the double or single geered windlass, as described in group first, with group third; that is, the second cylinder having the retaining beam, friction pulley, and weighted lever, as described, to be operated and used substantially in the manner and for the purpose herein above set forth and described; and in combination with these the cross head and rail-way as described."

The machines used for stretching consist of windlasses and bars, with pins projecting from them to hold the punched ends of the pieces of leather intended to be riveted together to make belts. The first machine is employed to stretch the short pieces, and the second machine is of much greater length, to stretch the entire length after the pieces have been put together.

---

23. For *Improvements in Machinery for Planing and Sawing Lumber;* Thomas J. Wells, New York, April 11.

The claim in this patent is limited to an improvement in the mode of feeding or moving forward the board to the saw or plane by means of reciprocating clamps, instead of feed rollers, or a carriage operated by a ratchet wheel and bands—the clamps being made to lift from the surface of the board to move back preparatory to another operation.

Claim.—"I do not intend to limit myself to means herein described of giving motion to the clamps, and I do not claim, generally, feeding saw-mills by clamps attached to slides, nor the use of the clamps for this purpose; but what I do claim as new and of my own invention, and desire to secure by letters patent, is the combination of the slides with eccentric clamps slightly pressed together, and so formed upon their faces, that, however the thickness of the stuff may vary, the line drawn as a radius from the face of the clamp at the point of contact with the stuff shall always make nearly the same angle with the face of the material and the direction of the feed.

---

24. For *Improvements in the Machine for Making Bricks;* Samuel Lowery, Philadelphia, Pennsylvania, April 18.

The patentee says,—"The nature of my invention consists in making bricks on railroad cars (peculiarly constructed for that purpose) in passing or descending an inclined plane, at which time, the clay on the cars is pressed, formed, and made perfect in bricks, in such a way, that, when the cars arrive at the foot of the inclined plane, the

perfect ready made brick may be received from the cars and the operation renewed."

There are two inclined plane railways on which run two sets of cars, the upper surfaces of which are properly adapted to the reception of moulds, and as these descend the inclined plane, after having been filled with clay, they pass under a roller (or rollers) which presses the clay, and then under a knife (or knives) by which the surplus clay is removed.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the mode of making bricks, in descending an inclined plane, as heretofore described, and in combination therewith I claim the rollers to press the clay into the moulds, in the manner as described herein, by one or more rollers. Also, in combination with the above, I claim the scrapers and finishing or polishing knife, for the purpose and use as mentioned above, in this mode of making bricks."

---

25. For an *Improvement in the Machine for Straightening Tobacco;* George W. Macon, Louisburg, North Carolina, April 18.

This machine consists of two sets of wheels on two shafts, one above the other, the two sets of wheels running on each other with their peripheries covered with leather. The spaces between the faces of the wheels are of such size as to give the required form to the band of tobacco; and for the purpose of guiding in the leaves laterally, there is a series of small horizontal rollers on the end of hinged arms or guides, so that the rollers can be set as may be required relatively to the faces of the wheels.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is a series of wheels having adjustable guiders and rollers between them, constructed, arranged, and combined in the manner and for the purpose herein set forth."

---

26. For an *Improvement in the Cultivator;* Nathan Ide, Shelby, New York, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the teeth in two rows, in combination with a pair of wheels, the treads of which are in a line midway between the points of the two rows of teeth, substantially as described."

---

27. For *an Improvement in the Corn Sheller;* Waldren Beach, Baltimore, Maryland, April 18.

This is for an improvement in that class of corn shellers in which the corn is shelled by driving the ear through a hole, and consists in forming the hole by a series of spring bars arranged in lines tangen-

tial to the circle of the hole thus formed, or by means of curved springs.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the elastic stripping bars in combination with the open frame, forming the apparatus or machine for shelling corn in the manner described, whether the spring bars be arranged in the manner above described, or in any other mode substantially the same."

---

28. For an *Improvement in the Machine for Cutting and Raking Grain;* Clinton Foster, Laporte, Indiana, April 18.

In this machine the grain is cut by a set of cutters projecting from the edge of a vibrating bar, and acting on the grain between a series of fingers, and the improvement patented consists in the peculiar manner of constructing the rake by which the grain is delivered from the platform on which it falls when cut. The platform is made with a series of grooves in which the points of the rake slide as they are operated by the vibration of a lever that receives motion from tappets on the driving wheel.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the rake, and its connexion with the floor of said machine, as herein described."

---

29. For an *Improvement in the Pocket Book and Watch Safe;* Joseph Cotton, Amherst, Massachusetts, April 18.

This is simply a metallic clasp made of two plates hinged together and provided with spring, bolt, and catch, for fastening, this clasp being properly adapted and secured to the edges of a coat pocket.

Claim.—"I claim the combination of the spring, bolt, and catch, for fastening the pocket-book and watch safe, the construction and operation of which are herein above described, as my invention."

---

30. For an *Extension Frame for Bedsteads:* C. S. Debow, New York city, New York, April 18.

The patentee says:—"The distinguishing character of my invention is the employment of the well known series of cross levers familiarly known as "lazy tongs," placed in a horizontal position, but turned edgeways for supporting, while they can be contracted or extended at pleasure; any number of these being placed parallel, and at a sufficient distance apart, for the purpose intended, and connected by cross bars for purposes above named; when extended forming a bedstead or other supporting frame; and when contracted occupying the smallest possible space.

Claim.—"Having thus fully described my improvement, what I claim as new, and desire to secure by letters patent, is the combination of two or more series of cross levers for extension and support,

arranged in the manner and for the purpose set forth, and combined with cords, webbing, or chains, which connect the butments, as above described."

---

31. For *Improvements in the Magnetic Letter Printing Telegraph;* Royal E. House, New York city, New York, April 18.

The publication of an account of this patent, the specification of which runs through some twenty-five folio pages, would carry us beyond our limits, particularly as it has already been published in several newspapers.

Claim.—"What I claim as my invention, and not previously known in the above described magnetic letter telegraph, is—

"*First.* The manner in which I arrange and combine the finger keys, a key shaft, and a circuit wheel, respectively, for the purpose and substantially as herein described.

"*Second.* The combination of the escapement with the type wheel, by means of pins in the side of said type wheel corresponding in number with half the number of letters and other characters which the type wheel is constructed to form, and the above combination and arrangement of the escapement and type wheel in combination with magnets, as herein described, and for the purpose herein stated.

"*Third.* The combination of the type wheel with the lever, by means of pins fixed in the sides of said type wheel equal in number to the number of letters and other characters formed, (and by other characters I mean as well blank spot as the letters and dot,) for the purpose of regulating the motion of the shaft, to carry the paper cylinder to and from the type wheel, all as described in said specification.

"*Fourth.* The manner of combining the shaft with the lever, by means of the pin, and projections on said wheel.

"*Fifth.* The combination of the lever with the hydraulic regulator, to produce the effect herein pointed out, and in the manner herein described.

"*Sixth.* The manner of producing and regulating the several motions of the paper cylinder by the combined action of the several parts respectively, as herein described, viz: The hydraulic regulator, the wheel, the lever, the type wheel, the eccentric shaft, and the rods connected therewith, the ratchets or catches, and the posts as herein described. I also claim the manner of applying the plumbago to blacken the type, as herein described.

"*Seventh.* The combination of the composing apparatus with the magnet for the purposes specified."

---

32. For an *Improvement in the Plough;* Samuel Witherow, Gettysburg, Pennsylvania, April 18.

The point of this plough (called in the claim the tongue) is let into the land side by a projecting tongue fitted to a recess which is wider at the back than the tongue, so that the back end of the tongue may be moved up or down to depress or elevate the point—the back edge

of the tongue being notched as well as the back of the recess to hold the point in any desired position.

Claim.—"Having thus fully set forth the nature of the improvement, and the manner in which it is constructed, what I claim therein as my invention, is the arrangement by which the tonguec an be raised and lowered at the point, as above described."

---

33. For an *Improvement in the Plough;* Joshua M. C. Armsly, Worcester, Massachusetts, assigned to Ruggles, Nourse, and Mason, Boston, Massachusetts, April 18.

This is an improvement for regulating or guiding the plough, and consists of a plate attached to the forward end of the plough beam having radial teeth on its surface to receive projections or ribs from the surface of an adjustable plate, which is secured in front of the plough beam by a bolt passing through a long slot in the adjustable plate, by means of which arrangement the draught rod, that is attached to the beam at its junction with the standard, and which passes through a hole in the lower end of the adjustable plate, may be elevated or depressed, and moved to the right or left, by shifting this plate, the teeth in the other plate preventing it from turning when set.

Claim.—"What I claim as my invention, and for which I desire to secure letters patent, is the circular plate, with the cogs, teeth, or projections thereon, in combination with the guide, having ribs, spines, or projections formed on it, in the manner and for the purpose described, to prevent the lower end of the guide being moved laterally or sideways by the power of the team."

---

34. For *Improvements in the Pump;* David G. Colburn, Wilmington, Vermont, April 25.

This is for an improvement in the pump, by means of which the water in the barrel of the pump may be returned into the well; but as the claim refers to, and is dependent on, the drawings, we are under the necessity of omitting it.

---

35. For an *Improvement in the Manufacture of Spoons;* Joel Hall, 2nd, Willingford, Connecticut, April 25.

The improvement for which this patent is granted relates to the mode of holding a wire in a mould for casting spoons, so that the spoons shall be cast thereon.

Claim.—"I do not claim as my invention the enclosing a wire in the handle of a spoon. This has already been done; but I do claim as my invention and improvement, and desire to secure by letters patent, the fastening, or holding the wire, preparatory to enclosing it in the handle of a spoon, by, to, or at either side of, either part of the mould, substantially in manner and form as specified above."

36. For an *Improvement in the Machine for Cleaning, Heckling, and Dressing Flax and Hemp;* B. Langdon and Amos Salisbury, Troy, New York, April 25.

The flax or hemp is acted on by a series of knives and beaters, arranged on a rotating stock, the rows of beaters and knives alternating —the beaters are parallel with the shaft, and the knives run in the direction of the periphery. The stock, thus armed, works in a casing, near the upper part of which, there is an aperture for the feeding in of the hemp, and beyond this a roller, against which the beaters, &c., act, and at the bottom a grate.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the knives and beaters, constructed and arranged in the manner and for the purpose set forth; and, in combination therewith, we claim the arrangement of the perforated cover, the roller, and the grate, in the manner and for the purpose set forth."

---

37. For an *Improvement in Curry Combs;* William Wheeler, West Poultney, Vermont, April 25.

The patentee says,—"I construct my curry combs generally of three longitudinal bars of sheet metal, united by rivets to two transverse bars, one at each end, and one at the middle of the instrument; there being open spaces formed by the junction of these bars, or plates, through which a large portion of the dust, which would otherwise lodge in the comb, escapes in the act of using it.

"The three longitudinal bars are in a trough-like form, being bent twice at right angles, by which means they are rendered perfectly unyielding. The teeth are made along the edges of these trough-like pieces, and they are sometime rounded off at their ends to remove their angular terminations; the bars constituting the comb being of one uniform length."

Claim.—"Having thus fully described the nature of my improvement in the curry comb, what I claim therein as new, and desire to secure by letters patent, is the combining of the trough-like bars which constitute the comb teeth with the other parts, in the manner set forth, so as to constitute a curry comb with an open back. I do not claim the trough-like combs, or the hollow back, individually, but only in their combination, as herein fully made known."

---

38. For an *Improvement in the Water Wheel;* James Deniston, Lanier, Ohio, April 25.

This wheel consists of an inverted frustrum of a cone, to the periphery of which are attached the buckets, which project radially, and run down in a curve from the upper to the lower edge. The water is delivered on to the wheel through inclined shutes.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the cone, conical hoop, and curved floats, substantially of the form and in the manner set forth, for the

purpose of forming a conical percussion water wheel. I also claim, in combination with my improved water wheel, the angle of inclination, and peculiar arrangement of the water shutes, for the purpose of producing the action of the water upon the wheel, substantially as herein set forth."

---

39. For *Improvements in Machinery for the Manufacture of Hat Bodies;* Henry A. Wells, New York city, New York, April 25.

The patentee says,—"My improvements consist in feeding the fur, (called the stock,) after it has been picked, to a rotating brush between two endless belts of cloth, one above the other, the lower one horizontal and the upper one inclined, to gradually compress the fur and gripe it more effectually where it is presented to the action of the rotating brush, which, moving at a great velocity, throws in a chamber or tunnel, which is gradually changed in form towards the outlet where it assumes a shape nearly corresponding to a vertical section passing through the axis of the cone, but narrower, for the purpose of concentrating and directing the fur thrown by the brush on to the cone; this casing being provided with an aperture immediately under the brush, through which a current of air enters, in consequence of the rotation of the brush and the exhaustion of the cone, for the purpose of more effectually directing the fibres towards the cone, which is placed just in front of the delivery aperture of the chamber, or tunnel, which aperture is provided at top with a bonnet, or hood, hinged thereto, and at the bottom with a hinged flap, to regulate the deposit of the fibres on the cone, or other former, with the view to distribute the thickness of the bat wherever more is required to give additional strength. As the fibres are only held to, and on, the cone by the pressure of the surrounding air, in consequence of the exhaustion of the cone, or former, preparatory to the suspension of this pressure, some means must be adopted of holding and retaining the fibres composing the bat, and it is obvious that this delicate web, thus formed, has not sufficient tenacity to admit of removing it from the cone, or former, before the hardening process; and therefore my invention also consists in covering the bat, before it is removed from the cone, or former, with felted or fulled cloth, and then employing one or more perforated metallic cones, one to put over the bat after it has been surrounded with the moist felt or cloth, for the purpose of making pressure on the fibres, and to admit of the circulation of hot water, when the whole is immersed therein, to harden the bat preparatory to felting,—and the other, to be placed within the perforated metallic cone on which the hat has been formed, and which is necessarily thin and weak, for the purpose of resisting the pressure of the surrounding water consequent upon a partial vacuum produced within when the whole is withdrawn from the water."

Claim.—"What I claim as my invention, and desire to secure by letters patent, in the machinery above described, is the arrangement of the two feeding belts, with their planes inclined to each other, and passing around the lips, formed substantially as described, the better

to present the fibres to the action of the rotary brush, as described, in combination with the rotating brush and tunnel, or chamber, which conducts the fibres to the perforated cone, or other former, placed in front of the aperture or mouth thereof, substantially as herein described.

"I claim the chamber into which the fibres are thrown by the brush, in combination with the perforated cone, or other former, placed in front of the delivery aperture thereof, for the purpose and in the manner substantially as herein described; the said chamber being provided with an aperture below and back of the brush, for the admission of a current of air to aid in throwing and directing the fibres on to the cone, or other former, as described.

"I also claim the employment of the hinged hood, to regulate the distribution of the fibres on the perforated cone, or other former, as described. And I also claim providing the lower part, or delivery aperture of the tunnel, or chamber, with a hinged flap, for the purpose of regulating the delivery of the fibres to increase the thickness of the bat where more strength is required, as herein described, in combination with the hood, as herein described.

"And, in the process, I claim the hardening of the bat whilst on the perforated cone, or former, and preparatory to its removal therefrom, by immersing it in hot water, as herein described.

"I also claim covering the bat with felted or fulled cloth before it is removed from the cone, or former, as described.

"And, finally, I claim the employment, in combination, of both of the perforated cones—one for making pressure on, and retaining, the fibres of the bat until hardened, and the other to prevent the collapse of the cone, or other former, on which the bat is formed, substantially as herein described."

---

40. For an *Improvement in Mills for Grinding Grain, Paint, &c.;* Wm. Broughton, London, England, April 25; antedated July 22, 1845.

This improvement consists in giving to one of the stones a lateral reciprocating motion, instead of a rotary, as heretofore.

Claim.—"Having thus fully described the manner in which I construct my apparatus for grinding grain, drugs, colors, and other substances, what I claim therein as new is the manner, herein described, of giving to the stones, suspended in an inclined position, and capable of adjustment in their degree of inclination, a longitudinal reciprocating motion, instead of the revolving or circumlinear motion heretofore employed; the respective parts of the apparatus by which this is effected being arranged, combined, and operating substantially as herein made known."

---

41. For an *Improvement in Water Wheels;* Ralph Summers, Seneca Falls, New York, April 25.

Claim.—"Having thus fully described the construction of my wheel, what I claim therein as new, and desire to secure by letters patent,

is constructing the wheel so that the water shall be received upon an inclined surface, extending from the eye to the periphery, and thence entering the passage upon the same surface undiminished in width; said passage increasing in the direction of the axis, and diminishing in the direction of the radius, so that the areas of all its sections shall be substantially equal, and so located and extended that the water shall all be discharged immediately outside the periphery in a thin tangential sheet, whose plane is parallel to the axis, the whole being constructed and combined substantially as herein set forth."

---

42. For an *Improvement in Mail Bags;* Henry Johnson, Washington, District of Columbia, April 25.

Claim.—"Having thus fully described the nature of my improvements in mail bags, what I claim as new therein, and desire to secure by letters patent, is the manner in which I have formed and arranged the roller mouth-piece, as described. I also claim the combination of the secondary mouth-piece with the mail bag, arranged substantially as set forth. I likewise claim the use of a flexible strap, or belt, as a substitute for the chain; said strap, or belt, being made reversible, and labeled on its opposite side, by the use of which strap additional security is attained, the destination of the bag is indicated, and lightness and economy of construction are promoted."

---

43. For *Improvements in the Apparatus for Printing Calicoes, &c.;* Robert Ferguson & John Clark, Glasgow, Scotland, April 25, 1846; antedated September 14, 1844.

Claim.—"Having thus described the nature of our invention, and the manner of performing the same, we would have it understood that we make no claim to the applying India rubber, or Jeffery's patent marine glue to the surfaces of fabrics or materials, that process being well understood and commonly employed for various purposes; and we would have it understood that what we do claim, is the application to cylinders, or bowls, for printing machines for calicoes and other fabrics, of a smooth and elastic surface, in manner described.

"2nd. The applying an elastic bed, or surface, for block printing, as explained."

---

44. For *Measuring Garments preparatory to Cutting;* Henry Donges, Borough of Newport, Perry county, Pennsylvania, April 25.

This consists of a standard, to which is jointed a strap made of joint links, and on which slides a jointed sliding arm, by means of which all the measurements can be taken with accuracy.

Claim.—"What I claim, and desire to secure by letters patent, is the combination of the standard, the hinged, or jointed strap, and the jointed sliding arm."

45. For an *Improvement in Mills;* Jonah F. Ostrander, New York city, New York, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making of the surfaces of the stones, or metallic plates, between which the material is ground, the one convex, and the other concave, the convexity and the concavity being hemispherical, or of the form of spherical segments, and giving the movable plate or stone a compound movement, consisting of the following motions, viz: an oblique gyrating motion of its axis around the axis of the fixed plate, and of a rotating motion around its own axis, substantially as described; the whole forming a mill for grinding paint, grain, &c."

---

46. For a *Composition of Matter to be used as a Substitute for Type Metal, and on which Impressions can be made with Types, &c.;* Josiah Warren, Harmony township, Indiana, April 25.

As this invention gives promise of being very valuable we insert the specification entire.

"Moulds, or matrices, are made of a tough, strong clay, mixed with silex in impalpable powder in sufficient quantity to prevent cracking. These materials are made with water into a strong putty, and kneaded very thoroughly, until it has acquired all the toughness that can thus be imparted to it.

"This mixture is now softened with water till it will spread easily and smoothly upon a metallic plate; the thickness of coat varying, according to the work to be done, from the thirtieth to the tenth of an inch.

"The plates, thus coated, are allowed to become about half dry, so that a type impressed into them will leave a smooth *fac simile* of itself.

"Into this coating, forms are impressed, as hereafter described in stereotyping plates. These forms may either be an original design, or impressed by an original to obtain a copy. When the coating is required to continue moist a longer time than the above, a heavy coating, with additional silex, from a twelfth to an eighth of an inch thick, is first spread upon the plate, and, immediately afterwards, the coating first described is spread upon the under coating. It is well to spread, with a light brush, a little thin gum Arabic paste between the two coatings, but not indispensable.

"The above described matrices are used for music, maps, and similar open work; but for fine, close, or shaded work, and for writing, the coating should be of very fine clay, without any admixture of silex, more than is chemically combined to form the clay. This clay should be of such a nature as will admit of its being spread in the form of a thin mortar, to the thickness of one thirtieth of an inch, without showing any cracks in drying. Clay of this quality is found along the banks of the Ohio river, near Evansville, Indiana.

"When the coating is intended for a close *italic* handwriting, it may be spread with a tool so constructed as to leave furrows in the

surface at such suitable distances as the writer may desire to have his lines; when this becomes hard enough to cut without following the tool, it may be slightly brushed over with a little olive or linseed oil. The writing is done in the furrows with any suitable tool.

"To write a copper-plate, or running hand, or for close drawings, the following is a good process: Mix a small quantity of gum Arabic paste with the mortar made of the pure clay, as above described, enough to change the color of the clay a shade darker when dry. Let this coating get quite dry, and brush it over slightly with oil. With another brush moisten each line or furrow before writing on it.

"The writing may be done in the ordinary manner, never allowing the tool used to go quite down to the foundation plate. The cast from this matrix will present a slightly uneven surface, which may be gently ground down with a hone or fine whetstone.

"The following process may be used as a substitute for the method above described:

"Spread a plate with pure clay, say one thirtieth of an inch thick, or as thick as will dry without cracking; when dry, heat it sufficiently to melt wax. Then rub over the surface a little beeswax, stearine, or tallow, and allow the plate to cool. When cold, spread on another coating of pure clay in which a little olive or linseed oil is thoroughly mixed. This should be worked on as soon as it is sufficiently dry to allow the tool to work freely.

"A great variety of clouded, wavy, or smoky effects, either as parts of a picture, or as tinted grounds, are instantly produced in a matrix by wetting the surface to a creamy softness and applying a brush, or toothed tool, with such motion as may be adapted to the design. This may be termed the *Hylographic process.*

"Type composition, or *silicate of lac.*

"Take one pound of good shellac, say four ounces of good clean tar, melt together over a gentle fire, and then stir into this mixture two pounds of fine siliceous sand. When thoroughly mixed, turn out and flatten into thin sheets, say an eighth of an inch thick. When cold it may be broken up for use.

"Place the matrix over a very gentle heat, in order to expel all dampness; raise the heat a little short of the hissing, or boiling point, then lay over the matrix pieces of the silicate sufficient to cast a plate an eighth of an inch thick. Lay upon this a wooden block of the length and breadth required, and about three-fourths of an inch thick. When the silicate is sufficiently softened to take the impression, take the whole to the press. Strips of wood, or other material, should be placed upon each end of the matrix plate, as guides or bearers, so that the cast shall be exactly type *height.* This being done, bring the press gently down upon it, until the bearers stop it. When cold, remove the cast from the matrix plate, and with a brush carefully wash the face of the cast without wetting the back of the block. The face of the cast, or type, may be polished with a hone or other suitable substance. It is now ready to take a proof, and, if perfect, is ready for the press. If not perfect, mark the imperfection on the proof-sheet, to be corrected by the following process of

"*Stereotyping.*—Take a metallic plate, previously spread with the coarse under coating, say four of fine sand to one of clay, covered with a coating somewhat finer, as first described; when this is so dry as to leave a clean impression from a type, it is ready for use. Next secure the imperfect cast of the type firmly in a square frame, or printers' *chase*, with guides or bearers, as before mentioned, to prevent too deep an impression.

The plate, with the clay coatings is now turned down upon the cast, and placed under the press. The pressure is gently withdrawn, and the imprinted matrix lifted carefully from the cast, or type. (The bearers should have springs, so constructed as to lift the matrix from the type on the withdrawal of the pressure.) This gives a new matrix, in which all the necessary corrections are made, and a new cast taken, as before.

"Stereotyping may be performed by the use of any of the matrices above described, using them when the moisture is sufficiently evaporated to leave a clean impression from a type, as before mentioned. Fine engravings, or any thing of that nature, may be more beautifully stereotyped by the use of a matrix of pure soft clay mortar, spread thinly upon a flat surface of dry clay. Press the engraving into it, and allow it to remain until the whole is sufficiently dried to lift the original from the matrix.

"Coats, or types, for printing *fac similes* of leaves, or other substances, the different parts of whose surface do not vary in height more than the twelfth of an inch, may be readily made by using those substances themselves to impress their form, either in the clay matrix or in a flat surface of the silicate previously prepared to be used as a type.

"The blanks between paragraphs of written or printed matter, whether in the original or in the stereotyped matrices, should be filled up with a mixture of about six parts of fine sand to one of clay, which should be applied about the thickness of cream. The margins may be filled with the same mixture, in the form of mortar, and may be applied with a knife or spatula."

---

47. For a *Machine for Drying Sized Paper;* Joshua Norton, Jr., Boston, Massachusetts, April 25.

A sheet of paper of any length can be dried in this machine after having been sized, by being first acted upon by a fan as it passes down an inclined plane composed of a series of small rollers, at the lower end of which, it passes around a large hollow cylinder heated with steam; then it runs back over a horizontal plane made in the same manner, then over a small roller, around a second large hollow cylinder heated by steam to a higher temperature than the first, and finally, around a third cylinder heated to a higher temperature than the other two. The paper is carried around nearly three-fourths of the circumference of the second and third cylinders, by passing around small rollers on each side of them.

Claim.—"I do not intend claiming the principle of drying sized pa-

per by the application of heat by steam, but what I do claim as my invention, and desire to secure by letters patent, is the principle of gradually drying sized paper of any length by means of the fan and the hollow cylinders, heated by steam to different degrees of temperature, in the manner and for the purpose herein described."

---

48. For a *Machine for Making Bricks of Clay in the Dry or Natural State;* John Simpson, Decatur, Georgia, April 25.

Claim.—"Having fully described my improved brick machine, what I claim therein as new, and desire to secure by letters patent, is the compressing dry clay, or clay in its natural state, into moulds, by the percussion of heavy beaters, combined and operating with the other parts of my machine, substantially in the manner set forth."

---

49. For *Improvements in Ploughs;* Harvey H. May, Galesburg, Illinois, April 25.

The patentee says,—"The nature of my invention consists in making a lip or projection on the land-side, fitted between the share and point of plough post or standard, to prevent the share from cleaving or separating from the land-side; in inclining the plough post to the right from the land-side, and passing to the right side of the beam for a right-hand plough, and to the left for a left-hand plough, having the top or upper end of the post formed in an angle, or elbow, to project across the top of the beam; and in giving to the mould-board a conical form, making the plough draw easy and do the work with great perfection."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is extending the standard, or post of the plough, above and topping over the beam, for the purpose and in the manner herein described."

---

50. *For a Core-box for making Sand Cores;* Henry Kellogg, assignee of Isaac Kellogg, New Hartford, Connecticut, April 25.

The patentee says,—"The nature of my invention consists in joining the two parts of the core-box together by a hinged joint, or any of the usual devices which will insure their exact meeting together, and then forming the parts into blunt cutting edges at the line where they meet together, and partially closing, and in that position filling the box with loose moulding sand, and then closing the box, to compress the sand."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is for an improved core-box for making sand cores for castings, having its parts well guided in opening and closing, and having cutting edges at their lines of meeting, so that no sand can be retained between them to prevent their closing exactly, and fitted to be placed partly open when loosely filled with tempered sand, which is suitably compressed by closing the core box, and the surplus sand

at the same time pared off and thrown out by the edges, and thus making the core uniformly solid, or hard, in all its parts, and of so exact a form that the hole made thereby in the casting will, in many cases, need no 'reaming;' thus making better cores, and with greater despatch, than have usually been made by 'reaming up,' so termed, by moulders and founders."

---

51. For an *Improvement in the Hay Press;* Daniel R. Allen, Cumberland, Maine, April 25.

This patent is granted for an arrangement of levers by which the follower of the press is forced up, and consists in connecting the short arm of a lever with a second lever, this connexion becoming the fulcrum of the second lever, the short arm of which is jointed to the follower of the press, and its long arm provided with a pulley, as also the long arm of the two, so that, by means of a rope or chain passing around them, the two can be drawn together, and thus force up the follower.

Claim.—"I am cognizant of the fact that toggles have been constructed, wherein one was a long lever, jointed between its ends to one end of a short arm, constituting the other toggle, and which turned upon a pin, or fulcrum, at its opposite end; the power which operated the said toggles being applied to but one end of them, viz: the long lever. I do not claim such; but that which I do claim, is the extended levers, as made and combined together, and having the power which operates them applied to both of them, and operating upon them as above described."

---

52. For a *Machine for Rolling Tobacco;* Wm. P. Marston, Danville, Virginia, April 25.

Claim.—"What I claim, and desire to secure by letters patent, is the arrangement of a series of rollers in a circle in a hinge or folding frame, with proper gearing to give them all a similar motion, in combination with a feeding apparatus, as described; the whole being constructed, combined, and operating substantially as set forth."

---

53. For a *Machine for making Hommony;* Wm. Y. Singleton, Springfield, Illinois, April 25.

The corn is crushed by a wheel that travels around in a circular trough. The shaft which carries around the crushing wheel also carries the elevators, sieves, &c., for removing and screening the corn as it is broken.

We have to omit the claim, as it refers to the drawing, and could not be understood without it.

---

54. For an *Improvement in the Ventilator, for the tops of Chimneys;* Michael Collins, Boston, Massachusetts, April 25.

In this case we are also under the necessity of omitting the claim, because of its reference to, and dependence on, the drawings.

Additional Improvements.

1. For a *Furnace for Burning Bricks;* Joel W. Andrews, Norristown, Pennsylvania, April 4, 1846; added to original patent, bearing date March 21, 1843.

Claim.—"Having thus fully set forth the manner in which I construct and use my kiln for burning bricks with anthracite or other coals, what I claim as new, and desire to secure by letters patent, is the two principal flues passing outside of the kiln, one on each side, and one centre flue, passing through the centre and under the floor of my kiln. These main flues are connected with lateral flues, or branches, (as described in my original patent,) necessary to conduct the wind required under each fire or into each air chamber. I have, in the foregoing description, given that form and arrangement of the respective parts which I deem the most convenient, but without intending thereby to claim any thing claimed and covered in said letters patent granted the day and year within mentioned, No. 3,016; also without intending thereby to limit myself in these particulars, but varying the same as I may find expedient, whilst I attain the same end by means substantially the same, in the manner represented and made known."

FRANKLIN INSTITUTE.

Committee on Science and the Arts.

Explosion of the Locomotive Engine "Neversink," upon the Reading Railroad.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred the examination into the causes of the explosion of the locomotive engine "Neversink," upon the Reading railroad, on the evening of the 14th January last, Report:—

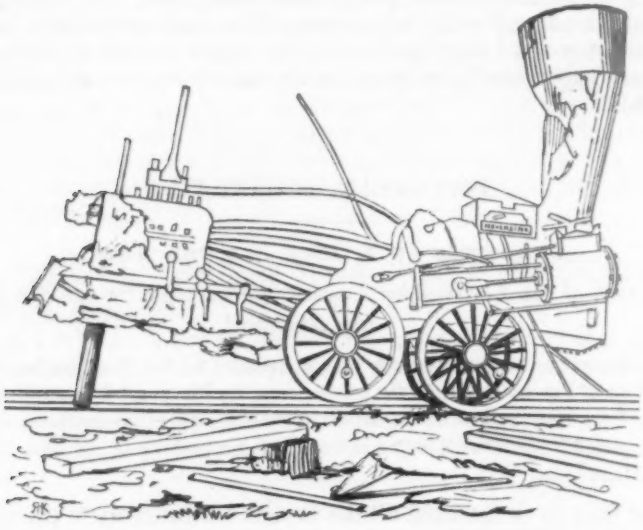
That they have collected all the evidence bearing upon the subject which they could obtain, and have visited Reading for the purpose of examining the wreck of the engine; and they desire in this place to return their acknowledgments to the officers of the Reading Railroad Company, and especially to Mr. G. A. Nicolls, the Superintendent, for their very great courtesy and kindness to the committee, in facilitating, in every possible manner, their examinations, and putting them in possession of all information having a bearing upon the object of their research. The following is the result of their inquiries:—

The engine Neversink was originally built by Baldwin, and sent upon the road in April, 1836. It then weighed 10½ tons, and had six wheels, two of which were drivers. The engine was thoroughly re-

newed and rebuilt by the Reading Railroad Company at their Reading depot, in April, 1846, and was changed to an engine of 19 tons, on six wheels, all connected drivers.

In rebuilding it, four plates in length at the fire-box end of the cylindrical part of the boiler were retained, and 1½ sheets in length were added at the front end of the boiler. The new iron was five-sixteenths of an inch in thickness, the old one-fourth of an inch.

The vertical part of the boiler was 51 inches in diameter; the fire-box was 39 inches long, 37 inches wide, and 44 inches high; the crown was stayed with wrought iron bridge bars, and was so strong that it received no damage from the explosion. The horizontal portion of the boiler was 41½ inches in diameter, and 11 feet six inches in length between the tube-sheets. The smoke-box was two feet three inches in depth; making a total length of boiler of 18 feet. There were 128 wrought iron tubes, two inches in internal diameter and one-eighth of an inch thick in the wall; they had copper ends at the fire-box tube sheets.



There was but one safety-valve, 2½ inches in diameter, placed upon the dome; there were four gauge-cocks, the lower one of which was eight inches above the crown-sheet, and the upper one about 14 inches above the lower.

The highest tube was 1½ inches below the crown of the fire-box, and 11½ inches below the top of the cylindrical part of the boiler.

The fire surface, reduced to fire-box surface, amounted to 309 square feet.

The cylinders were 13½ inches by 20. The driving wheels 46 inches in diameter.

It was a favorite engine upon the road, and had run, previous to alteration, in April, 1846, ... 71,010 miles.
Afterwards, ... 18,041 "

Total, 89,051 miles.

Upon their examination, the committee found the horizontal part of the boiler almost completely destroyed. In this part of the boiler the explosion had manifestly originated, commencing in the older iron which remained in the hinder part of the boiler. The tubes were, for the most part, still fast in the tube-sheets, but they were bent outwards at their middle, like the staves of a barrel. The steam pipe, as it passed through the boiler, was *collapsed*, but not broken. The outer shell of the boiler had been torn into fragments, and the rents had extended to the vertical part, the upper portion of which had been entirely torn away, so as to expose the fire-box, which was sound, but slightly caved in on the sides. The cylinders were unharmed by the explosion, but had since been removed. The quality of the iron appeared to the committee to be uniformly good.

There was, therefore, nothing about the engine to indicate that the accident had occurred from defects in workmanship or material, nor, indeed, did the tremendous power which was indicated, seem consistent with the idea of an originally defective boiler.

Through the kindness of Mr. Nicolls, the committee had an opportunity of examining Patrick Fagan, the engine driver usually in charge of the Neversink, whose testimony is in substance as follows, viz:—

That, when in the hands of a driver who understood it, the Neversink was the best engine he ever knew, but that no one who did not understand the engine, could tell, by the gauge-cocks, how much water there was in the boiler; that it would frequently throw water out of the safety-valve when the water-level was, in reality, below the second gauge; that the pumps were good, and had never given trouble when the water-level was kept up, and could always be made to act by opening the fire doors and cooling the fire down, but that when the water is low, and the engine hot, no pump will act; he "has worked the engine when, with both pumps on, he could not get the water up for an hour, but could always do so by running slow, and cooling the engine." Has carried 150 lbs. steam upon the engine, (the steam was then damp,) but believes that any engine is dangerous at that pressure, "as at that heat, a second will throw the water out." The pumps delivered the water into the boiler about six inches behind the smoke-box, and about half way up the tubes; the receiving valve was under the cylinder; the check valve between the cylinder and boiler, and the discharging valve close up to the boiler: the distance from the receiving to the check valve was about four or five inches, and about 20 or 24 inches from the check to the discharging valve. The engine was at this time in perfect order; had been brought down by the witness on the preceding Tuesday, and had laid over until Thursday night, when the witness went to the depot for the purpose of taking it up again, but

was recalled by a message from his sick wife, and the engine was entrusted to Jacob Salleburger, under whose charge it was when it exploded.

In reference to the behavior of the engine, Mr. Kirk, the foreman of the shops of the Company at Reading, remarks, that he was not aware of any peculiar difficulty about the Neversink, but that "all our large class engines are a little ticklish in carrying water." The cause of this we shall presently endeavor to shew.

The accident occured about 30 yards above Mill Creek bridge, and the watchman upon the bridge gives the following account of what he saw and heard:

He was standing in front of his door when he heard the engine coming, and, as it approached, he noticed the peculiar loudness and sharpness of the exhaust; the engine was then running very fast, and was not blowing off steam. As it passed the bridge, one of the persons upon the platform was stooping down, apparently looking in at the fire doors, and as he rose, he put his hand either upon the safety-valve or upon one of the stays; almost immediately afterwards, the witness heard a very loud roaring like thunder, which he is sure was not the escape of steam from the safety-valve; this lasted about 30 seconds, when the explosion took place, by which he was knocked down, and saw no more; when he got up he ran immediately to the engine, but was so engaged attending to the sufferers, that he paid no attention to the appearance of the engine.

Mr. Nicolls, Mr. Kirk, and Mr. Fagan, all testify that, when they saw the engine next morning, the broken ends of the tubes, as far down as the fourth row from the top, were blue from the effects of overheating; a member of the committee, however, who was on the ground at the same time, declares that he could not perceive this, though he looked for it, particularly; when the committee saw the engine, at Reading, no such appearance was visible, nor could it be expected, since a snow fell on the night of the accident, and subsequent oxidation would destroy all traces of the color.

Neither did the fire-box give any observable indications of an exposure to an unusual heat. Yet there is no doubt in the minds of the committee that the want of a proper supply of water was the proximate cause of the accident.

The evaporative power of these heavy engines is necessarily very great. Mr. Nicolls assured the committee that the Neversink was capable of drawing a train of 88 cars, weighing, loaded, 7½ tons each, (equal to 637 tons,) at a speed of 12 miles per hour. (1056 feet per minute.) Allowing the traction to be 7½ pounds per ton, (as experiments upon this road shew it to be,) this is equivalent to 153 horse power —requiring an evaporation of 2·55 cubic feet of water per minute.

Now, by the peculiar construction of these engines, rendered necessary by the restricted space allowable for the boiler, when the water-level stood two inches above the lower cock, the steam was confined exclusively to the hemispherical dome above the fire-box, the cubic content of which is rather less than 24 cubic feet. (23·8565 cubic feet.) The cubic content of each cylinder (13·5 × 20) is 1·657 (1⅝) cubic feet,

and, as two cylinders are drawn at once, the ratio of the cylindrical content is as 3·314 to 24, or more than one-eighth. When the water-level is at the upper gauge-cock, the steam room is nine cubic feet, and the ratio about one-third. Now, the most recent (and apparently the best) authority upon the high pressure engine declares, after nearly 30 years of practical experience, that "the steam space should be at a minimum 20 times as great as the space to be filled with steam in the cylinder. If it can be made greater, consistently with the other arrangements of the boiler, so much the better."* This is, of course, inapplicable in locomotive engines.

The reason, therefore, that these engines will throw water from the safety-valve, and from the gauge-cocks, when the actual water-level is dangerously low—and that, in the words of Mr. Kirk, they are ticklish in carrying their water, must be evident. The foaming in one of these engines must be incessant, and the danger of priming very great. The gauge-cocks, which, under the most favorable circumstances, are but indifferent indicators of the water-level, become, in this case, useless, and the engine driver must rely upon his experience of the engine and trust to incessant watchfulness alone, if he would avoid an accident.

A very remarkable fact about this explosion is, that the steam pipe passing through the upper part of the boiler, from the throttle valve to the cylinders, was *collapsed* and unbroken, as is well seen in the accompanying Daguerreotype portrait of the engine, taken after the explosion by Mr. David Monday, of Reading, and kindly lent by him to the committee. It is, indeed, possible that this may have been produced, during the explosion, by the sudden bending upwards of the tube, otherwise it would seem to indicate that the engine was throttled at the time of the explosion; an expedient which may have been resorted to for the purpose of avoiding the dampness of the steam, or to check the speed of the engine; but the fearful danger of which will be seen when it is considered that, if the steam was shut off but one-fourth, (the water being above the lower gauge-cock,) the pressure in the boiler would double itself in about one minute.

It seems useless to speculate upon the immediate cause of this terrible accident, since the death of all upon the engine has removed the direct testimony of the circumstances under which it occurred, except that of the watchman before referred to. From his evidence, however, it appears that the engine was under a very unusually heavy pressure of steam, and scarcely less certain that the safety valve was (accidentally or otherwise) fastened down.† Mr. Nicolls and Mr. Kirk both testify to the competency of the engine driver, who was in charge, and every one bears witness to his character for sobriety. That he may have been deceived as to the height of water in the boiler is possible from the character of the engine, although it is difficult to imagine how an experienced hand could have neglected the indica-

* Alban, on the high pressure steam engine, p. 90.

† After having his attention repeatedly called to the importance of this part of his testimony, he still confidently asserted that no steam was escaping from the valve at the time the engine passed him.

tions given by the increased pressure, as shewn by the rapid running of the train and the sharpness of the exhaust.

Dr. Alban, in his recent treatise upon the high pressure engine, before referred to, mentions a rumbling noise as often preceding explosions, and attributes it to the sudden loosening of the scale upon the boiler, and the increased access of water to unduly heated metal thus produced; (p. 18.) But the scale upon the tubes of the Neversink was not thick enough to produce any effect of this kind, nor does it appear to have been loosened to any extent. It seems, therefore, more probable to the committee that the roaring noise referred to by the watchman as preceding the explosion, may have been caused by the starting of one or more of the tubes at the forward end, and the consequent escape of the steam into the smoke-box, the sudden diminution of pressure consequent upon which, would cause the rise of water in foam over the heated tubes, and thus almost instantaneously produce a pressure which no locomotive boiler could withstand.*

Upon the whole then, it appears probable to the committee that the explosion of the Neversink occurred in this way:—

That the engine was running under a heavy pressure of steam, and that, owing to the defective indications of the gauge-cocks, the water in the boilers was permitted to get below the upper tubes, which thus became unduly heated; that the rapidly increasing pressure (assisted, perhaps, by an injudicious partial closing of the throttle valve) caused the starting of one or more of the tubes from the forward tube-sheet, and this sudden relief of the pressure caused a foaming in the boiler, by which the water was thrown over the heated tubes, and being thus rapidly evaporated, caused an instantaneous increase of tension, which the additional openings were incompetent to relieve, and thus produced the rupture of the outer shell of the boiler. This, however, is intended only as a plausible suggestion, and by no means as a confident affirmation of the cause of the explosion.

But whatever hypothesis may be adopted to explain this unfortunate accident, its investigation has forcibly called the attention of the committee to several matters which they believe to be of sufficient practical importance to deserve the attention of the Institute.

First. The necessity of providing all steam engines with a second safety-valve, of large dimensions, regulated to the maximum pressure which the engine is intended to bear, and placed beyond the control of the engine-man. It is true that this will entail upon the owners the trouble of frequent examination to maintain the efficiency of such

* The boiler of the Neversink being of wrought iron, one-fourth of an inch thick, (at minimum,) and 41½ inches in diameter, would, according to Oliver Evans' rule, (Young Steam Engineers' Guide, p. 23,) sustain a pressure of 51·4 atmos.

The formula is $p = \frac{2\,s\,t}{d}$:

Where p = the bursting pressure. s = a constant depending upon the tenacity of iron, =, according to Evans, 6400. t = thickness of iron in tenths of an inch. d = diameter, in inches.

$$\frac{12800 \times 2{\cdot}5}{41{\cdot}5} = 771 \text{ lbs.} = 51{\cdot}4 \text{ atmospheres.}$$

a valve, but this trouble will be more than compensated by the increased safety which will be procured by its use.

Secondly. The uncertainty of the ordinary gauge-cocks, as indicators of the water-level under the most favorable circumstances, and the deceptive character of their indications upon the modern locomotive engines, where the amount of work to be done and the restricted space which can be allowed to the boiler, necessarily confines the water and steam room, and renders the evaporation more tumultuous than in the larger boilers of stationary engines.

The incompetency of the gauge cocks to indicate the true water-level, especially under high pressures, is admitted by most writers upon the steam engine, (Pole, on the Cornish engine, pp. 61, 108, note; Alban, on the high pressure steam engine, p. 111,) and is noticed in the report of the Franklin Institute Committee on Explosions, (Journal, vols. xvii., p. 8, et seq.; xviii., p. 295,) who recommend the glass tube water-gauge, in which recommendation the present committee cordially join, believing that there are no objections to its use which cannot be easily overcome.

The committee have also seen in operation a new and simple instrument for indicating the true water-level, patented by Messrs. Worthington & Baker, and described at large in the Farmer and Mechanic, March 4th, 1847. How far this may be applicable to the locomotive engine, practical experience alone can determine; but the committee recommend it to the notice of locomotive builders. It may be seen upon the boiler at the works of Messrs. Merrick and Towne.

Thirdly. The committee would suggest the inquiry whether it is not feasible and advisable so to construct the locomotive engine that explosions, if they occur at all, shall take place in such a manner as to be less destructive to human life than they at present are. One of the great recommendations of the tubular boiler, when first introduced into use, was this very diminished liability to do injury, by allowing a tubular flue, of comparatively small size, to collapse, in place of the large cylinders, by which the boiler was at once emptied of its contents.

The perfect condition of the fire-box of the Neversink showed the committee how well the Superintendent of the Reading Railroad has guarded against the determining cause of the explosion of the Richmond, and the committee would earnestly recommend to him, and the ingenious mechanics with whom he has surrounded himself, as well as to our locomotive builders generally, to devote their attention to this matter of contriving some means by which the accidental explosions of these indispensable but dangerous machines may be rendered less destructive to those who are in charge of them.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, March 11, 1847.

Remarks respecting the Copper District of Lake Superior, made at the Monthly Meeting of the Franklin Institute, March 18th, 1847. By Dr. WILLIAM PETTIT.

The subject of mining for copper has been interesting the public mind for several years.

The scene of the chief mining adventure in search of this metal is in the vicinity of Lake Superior, in a border territory assigned by the United States to the State of Michigan in the settlement of the Toledo war question with Ohio.

The first government surveys of that region of country took place during the summer of 1845, whilst I was residing there. The survey was conducted by the late lamented Dr. Houghton, who, with a lineal sectional survey for the United States, combined a strict geological examination, and barometrical admeasurement of altitudes, attended with great labor, for the benefit of science alone. He penetrated the forests, and coasted the waters of the great lake in his frail shallop many thousands of miles, in the pursuit of his interesting object; manifesting an untiring industry, and encountering hardships that have seldom been equalled. Unfortunately, in the midst of his work, he fell a victim to undue temerity in attempting a night transit, in his little boat, in the face of an impending storm.

The treaty with the Chippewa Indians had been concluded in 1842, for this territory. And about the same time attention was directed thither, with a view of exploring the country for copper. Accordingly, in 1843, the Secretary of War granted certain "permits" to individuals, or companies, to examine certain tracts therein specified; and, if discoveries should render it desirable, the "permittees" were to have "leases," respectively, for the tracts permitted to be explored. The "leases" were to run three years, and were renewable three times. The term of tenure, therefore, was one year for the "permit," and nine years for the "leases," in all ten years. Pre-emption was *expected* to follow. Accordingly an Act of Congress was passed at the late session to sell to occupants, at $2·50 per acre, the extent of their "permitted" tracts. Other lands to the highest bidder; provided, the minimum price shall be $5·00 per acre.

The mineral land district was defined to extend westward, from Chocolate river on the east, to the Apostles' islands. Under the present law of Congress, however, I suppose that it will include the entire addition to the State of Michigan, from St. Mary's river on the east, some three hundred miles westward, to the State line, at the Montreal and Menominee rivers.

I can, on this occasion, speak only of the promontory called "Point Ke*w*enaw," (or "Kew*a*wenon,") which, from its base at the main land, across from Lé Anse (bay) to Elm river, extends some seventy miles northward, into the lake, terminating in what is called "the Point;" (of Point Kew*a*wenon.) A narrow strait occurs here, and Manitou island completes the rocky extension. A glance at the map (plate iii.) will illustrate my description.

A large portion of Kewawenon point is nearly separated from the main land by "Portage lake." A narrow isthmus, however, unites them. The path across this isthmus, three-fourths of a mile, is called the "Portage." The Indian and French voyageurs not unfrequently shoulder their bark canoes and carry them across, in going and returning, in their annual visits to La Pointe, from Saut de Ste Marie and Lé Anse. La Pointe, on Madaline island, (one of the Apostles' group,) is the place of paying the annuity. The "payment" is the scene of a great gathering of Indians, half breeds, and traders.

On this almost island point (Kewawenon) I resided with my family from the 4th month, (April,) 1845, until the 6th month, (June,) 1846. The climate is exceedingly salubrious and restorative to invalids. I know of no spot on the globe to which I would sooner recommend the impaired constitution to go with prospect of relief. Not only for a few weeks, or months, would it be profitable; but, in chronic cases, even a year, or more, spent in the bracing climate of Point Kewawenon, in Lake Superior, would be a safe course. Of the seventy persons under my charge during the time that I resided there, one was seldom heard to cough. The sickly recruited and the feeble grew strong.

In a word, let me say to invalids and the wearied with city life, that a period of six weeks, or two months, spent in making the trip and residing there, is, in my estimation, worth a dozen Cape May or Nahant visits.

Point Kewawenon being nearly surrounded by water may, perhaps, be the cause of the favorable temperature. The depth of lake Superior is such as to prevent its closing with ice, and the warmer water rising from beneath to the surface, and giving out a portion of its caloric, tends to preserve a uniform mild atmosphere in winter, with rare exceptions of a few days at a time; when a continuous norther of great severity reduces the mercury to zero. On one occasion, it fell to 6 or 8 degrees below, for a few hours. The average temperature of the 1st month, (January,) 1846, was about 20° Fahrenheit. It was sometimes as moderate as 40°. This, I believe, in latitude 47½ N., is remarkable for the western hemisphere. A depth of from 16 to 20 feet of snow fell during the five months of winter, but (as the earth never freezes) it seldom attained a depth of more than from three to five feet. It is also worthy of remark that it seldom rains there in winter.

It will be proper to introduce the subject of copper mining with stating some of the prominent features of the rock formation on Point Kewawenon as it strikes the eye; with little pretension, by the way, to geological technicalities. This deficiency, however, is the less to be regretted, as it is your good fortune to be able to command, I doubt not, if you desire it, in a scientific and satisfactory way, the history of this interesting section of country, from the lips, or the pen, of your own able State geologist, Professor Rogers, whom I had the happiness to meet in the Lake Superior mineral district.

Three leading divisions of the surface formation may be noticed. *First*, The highest mountain ranges, varying from one to three miles from the coast, are of "trap" rock: compact greenstone at the summits; and amygdaloidal, or cellular, at greater depths from the mountain

tops. This may be denominated the "primitive rock," and the only reliable matrix for metals. *Second*, The (old red) sandstone, lapping on to the declivities of the primitive trap range. The veins of spar (carbonate of lime, and quartz, sometimes laumonite, datholite, or analcyme) which usually accompany the "lodes" of metal, strike feebly through these sandstone strata, and afford no reliance for a workable "lode" of metal. The outcrop of this division is usually narrow. It preserves the same dip, of course, as the sides of the trap uplift, upon which it rests. *Third*, The "conglomerate" rock, (or *pudding stone.)* This is a sedimentary rock, formed of pebbles and larger boulders, evidently rounded by attrition upon one another from the action of water; in which element they have once been carried back and forth upon the bottom of the deep. These pebbles are of every variety of rock, and are now firmly cemented together with lime and the sand-like *debris* of former rocks. These boulders will generally, in breaking the conglomerate, part in twain, rather than at the line of union.

Mountains many hundred feet high are found on the Point, of this material; and it, too, preserves a regular dip—often overlying the "mother trap," or primitive rock, of which I have spoken. Sometimes the sandstone intervenes, as before adverted to. The outcrop of this formation along shore is very extensive. It is exceedingly hard, and difficult to quarry. The layers of conglomerate, of old red sandstone, and the "dykes" of trap and altered sandstone frequently alternate; but when we reach the main trap range, this primitive material prevails, and alternation ceases. The veins of spar are exceedingly bold and well defined in the conglomerate, and carry large masses of metal occasionally, both in the native state and in the ores; but the lodes in this material have, thus far, proved only "bunchy" and uncertain.

As the primitive formation, though occasionally granite, is, for the most part, "trap,"—so called from the *steppes* of the Alps, it having a step-like surface fracture at the outcrop—it may be proper to say a few words descriptive of it.

Trap rock is apparently a *lava* production; the result of volcanic fusion of different sorts of minerals into one mass. By the presence of water, perhaps, during the hot state, singular crystallizations occur throughout.

While on the subject, we may properly consider this species of rock under two heads, viz: the "greenstone" trap, which is compact; showing fewer marks of the action of water while cooling. This description of stone forms the *super*structure of the trap range, and varies from a few feet to one hundred feet, or more, in depth. And, secondly, "amygdaloidal" trap, which forms the *sub*-structure of these mountains, is of an open texture, abounding in cells; some empty, others filled with different substances. It happens, in the same piece of this description of rock, that we find some of the cells filled with a soft green substance called "chlorit;" others, with agate or carnelian; and others again, with copper or silver. The almond shape of these cavities, and of the substances filling them, gives name to the rock, *(amygdaloid.)*

From the abrasion of the rocky shore, these almond shape nodules of hard material, that formerly filled the cells, are picked up in abundance by visiters,—the softer substance of the rock having been pulverized to sand.

There is, on the coast, some 18 miles west of the extreme point, a harbor, where agate and carnelian, a few years since, were so plentiful, from this destruction of the cellular rock by abrasion, that it obtained the name of Agate harbor. This harbor became the scene of fashionable excursions for the officers and ladies of the garrison, nine miles below:—(Fort Wilkins, a military post, erected at Copper harbor in 1844–5.) They would go up in their open Mackinac boats, spend a day in gathering these crystalline gems along the beach, and, if overtaken by stormy weather, they were prepared to encamp out in tents until the return of a calm sea. I had an agreeable visit of the kind, with the gentlemanly commandant, Capt. Clary, and suite, in the spring of 1845.

Smoothly polished lumps, or boulders, of metal, have also been picked up frequently on the coast of Lake Superior: and, indeed, to the frequency of finding native metal along the shore, may be traced the origin, in part, of the present mining movement there. The finding, on the Ontanagon river, a boulder of native copper weighing 3700 pounds, and transferring it to Washington city, in 1843, likewise led to inquiry concerning that country; but, perhaps, more than all, the celebrated "green rock" of "voyageurs," (as the French and Indian boatmen are called,) which stood out of the water several feet at the lower entrance to Copper harbor, attracting the attention of the scientific, became the subject of analyses, and proved to be silicious oxide and carbonate of copper, rich in metal.

While tracing back towards the mountain the marks of the vein (or "lode") of calcareous spar, in which this green rock showed itself, a rich deposit of the black oxide of copper was found (by accident) near the garrison buildings at Fort Wilkins, which, upon survey, proved to be a continuation of the same "lode," though three-fourths of a mile further inland, from the site of the green rock in the margin of the lake.

Forty thousand pounds of this ore were shipped to Boston and yielded about 67 per cent. of pure metal. Nearly thirty thousand pounds of the ore of less value were mined at the same time.

This lode was found and worked in the conglomerate rock, and could not be relied on for regularity of yield, until we should penetrate the primitive formation below. Shafts were sunk, and the depth of 125 feet attained, but no signs of reaching the trap basin, in which this conglomerate sediment rested, having appeared, and the necessity occurring of erecting expensive pumping and hoisting apparatus, if prosecuted further, the Company were induced to retreat for further explorations to the range of trap hills from two to three miles from the coast.

In this formation, discoveries of a more satisfactory nature were soon made: especially on a leased tract ("No. 5" at U. S. Ord. Office)

about 25 miles further westward, the somewhat noted "Cliff mine" was found.

The specimens which are before you as well as many others that may be seen by the curious in these matters at my rooms, 188 Chesnut street, are from various mines, many miles apart, and mostly situated in the trap range spoken of.

The Cliff mine presents the extraordinary phenomenon of having produced a single mass of copper of, perhaps, 80 per cent. value, 50 feet in length, six feet deep, and an estimated average of six inches in thickness! How much larger the continuous piece of copper was is not known, as, after drifting along side of it into the Cliff mountain, it was chiefly cut away in parcels, and removed by cold chisels, wedges, sledges, and blasting; until, at length, being reduced to such dimensions, that the pieces were removable from the drift by the attachment of tackles and oxen. This was taken from the mine since the close of navigation last fall.

It is reckoned, besides the numerous masses of nearly pure metal that have from time to time been found in this mine, that several thousand tons of rock, containing from 6 to 25 per cent. of copper, are already mined at the Cliff mine, and ready for machinery to separate the metal.

Machinery for separating the metal from the rock, together with the necessary steam power, was sent out last fall, and has been in process of erection during the present winter. Operations therewith were to be commenced by the 15th ultimo.

One hundred men are employed already at the Cliff mine, and if no unforeseen mishap occur, way will soon be opened for several hundred more.

The peculiar situation of this lode renders it practicable to drain the mine for some 240 feet in depth, and an expensive adit, or drain, is already cut from the level, 240 feet from the top of the mountain, out through the rock and earth to the west branch of Eagle river, which drains the valley.

A trial shaft has been sunk in the rock 60 feet below the adit level, say, in all, 300 feet from the top, and the quality and quantity of metal in the lode does not at all diminish.

The lode is not horizontal, as most Pennsylvania coal and iron ore veins are, but vertical. So are most, or all, the veins, or lodes, found on Lake Superior, and the direction N. 28° E., is nearly at right angles with the strata of rocks and with the mountain ranges of primitive trap formation. The Cliff lode varies from five feet wide to two feet, and in some places extending to a much greater width, carrying metal, and 4 to 18 inches of this very rich metal.

On the same leasehold, (No. 5,) several other lodes have been discovered. I saw a lump or mass of copper, nearly pure, quarried from one of the new diggings, weighing about 200 pounds; and from another opening, a piece was taken of some 40 pounds. But neither of the new "prospects" compares favorably with the main Cliff mine.

A number of remarkable shots of pure silver have been struck in working the Cliff lode, varying from several pounds to slight traces, and more or less silver occurs throughout the product of this mine;

animating the adventurers with the probability that, while they continue to work for the copper, a rich deposit of silver, of great value, *may* yet be found.

Three miles from the Cliff location, in descending Eagle river, on lease No. 2, many points of silver have been found with the copper, and a singular boulder of silver, quite pure, weighing seven pounds, was mined there. This beautiful specimen fell under my own observation.

They have erected machinery, propelled by water, at this place, to separate the metal from the rock.

Opposite Sand bay, at the Copper Falls mine, I descended a shaft some 40 feet, to examine a mass of copper found in the lode. I should, from the measurement made when I saw it, say that 8 to 10 tons were uncovered, and the full extent was not then ascertained. A considerable sprinkling of silver was found with the copper at this mine also.

At Eagle harbor, 12 miles eastward from the Cliff, a large mass of copper in a lode of laumonite spar was in process of excavation when I left. This discovery, like the one at Copper harbor, occurred in an unfavorable formation. It was, here, of a trappean character; but only a narrow outcrop, showing it to be but a dyke of trap, shot up between strata of conglomerate and altered sand stone, and giving slight hope of permanence.

By tracing the lode back, however, to the mountain, the discovery may, it is hoped, be renewed in the primitive range of mother trap.

At Grand Marais, and at Lac Labelle and vicinity, interesting discoveries have been made. Also at the North-west and Suffolk mines.

At Agate harbor, and the diggings between that point and Copper harbor, promising mines were found of sulphuret and native copper. A single piece was sent to Boston from lease No. 15, weighing about 700 pounds, which now lies in the Exchange there. But these mines were found in conglomerate rock also, and, of course, little confidence could be placed in their durability, unless machinery, at great expense, were provided, to enable the adventurers to pierce the primitive rock below at an unknown and, perhaps, a great depth.

On the *southern* border of lease No. 4, (at Copper harbor,) 2½ miles from the coast, an exploring party, after abandoning the lode at the fort, have discovered, in the lofty trap hills, what is reported a good workable lode.

Also, still nearer the extremity of Point Kew*a*wenon, other lodes are reported to have been recently found, on different tracts, by the respective companies who are exploring them.

On Torch lake, (a branch of Portage lake,) 15 miles westward from the Cliff mine, and at several points between the Cliff and Torch lake, discoveries have been made: at the North American, adjacent to the Cliff; at the Albion and Trap rock river locations, in particular, well defined lodes, carrying metal, have been discovered, and will doubtless be worked.

I may, before leaving the subject, advert to the new movements making further west, on Elm river; on the Ontanagon river; in the Porcupine mountains; and also on Isle Royale. It is said that several good mines are about being opened; and the Ontanagon dis-

trict, in particular, is named as promising well to the adventurers. I did not visit these western localities.

It is, perhaps, known, that the British government have become imbued with the Lake Superior copper spirit, and, desiring to have the north coast explored, numerous grants have already issued from the crown, confering 21 years permits, to that end.

I have a letter from an intelligent gentleman who was engaged to inspect some localities on the Canada side. He reports favorably.

I have no doubt but that there will be an abundant supply of this useful metal produced, in process of time, for the greatly enlarging demands of the American people, out of our own mountains.

Already, during the course of test experiments in Boston, there has been produced, of the Cliff mine product, a superior article of sheathing copper; and a fine vessel has gone to sea coppered with Lake Superior metal.

The quantity of silver, inseparable, by any profitable process, in each ton of the copper, is about equal to from $50 to $60 value. It is hoped and believed, by the scientific, that the increased resistance to corrosion by the presence of this amount of silver, will be found to enhance the value of the sheathing in proportion.

It may be rendering some service to those who may desire to enter that field of adventure, to state that miners now esteem it folly, on Lake Superior, to attempt to find workable lodes of metal in any other formation than that of the primitive trap, or the granitic uplift.

There are dykes of altered sandstone, and even trap dykes, which are shot up between the strata of conglomerate, that may mislead; but the findings of metal therein, will necessarily prove bunchy, and of uncertain continuance. [These dykes were illustrated in the lecture by diagrams on the black board.]

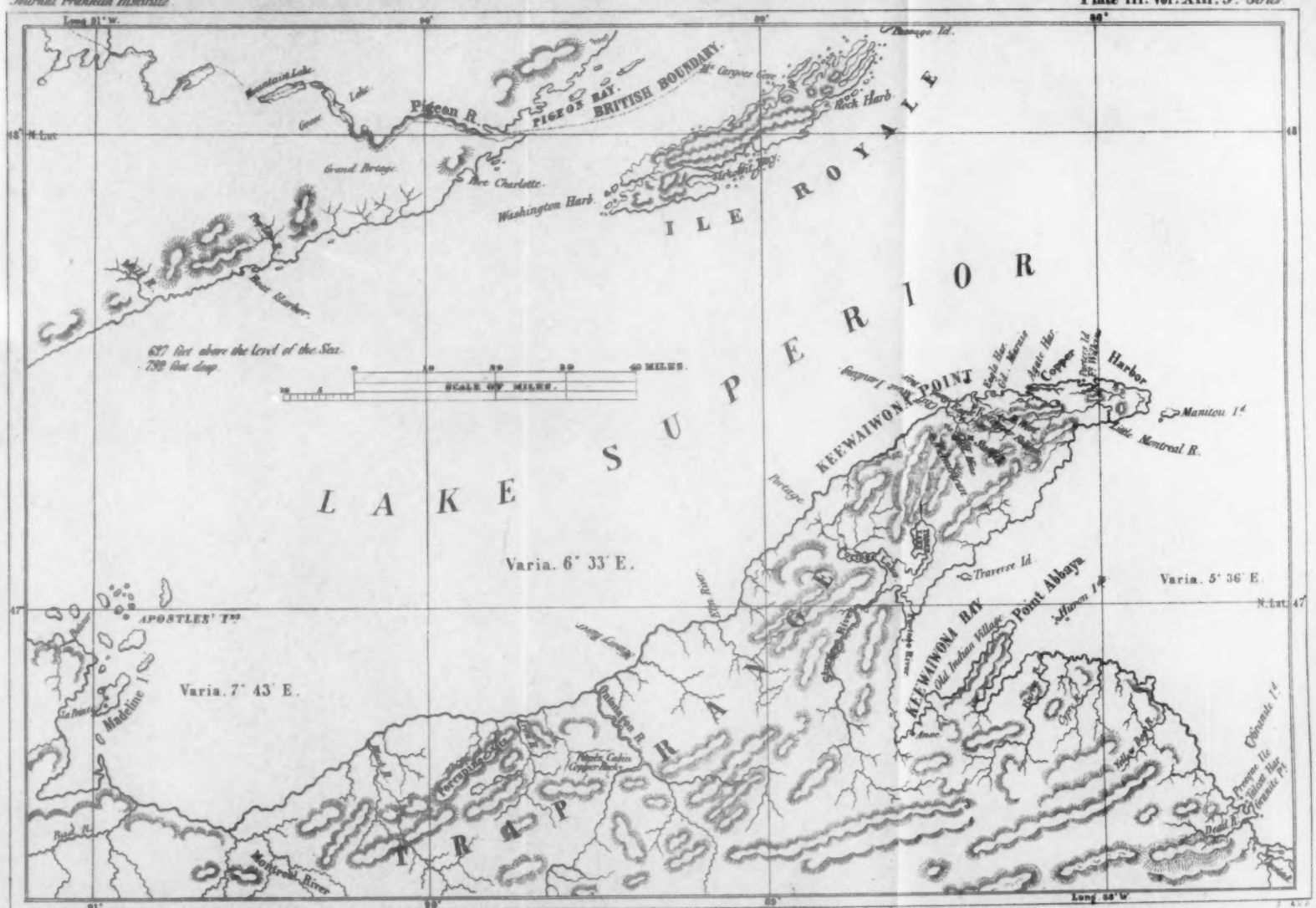
There is, however, no necessity of searching in these, as the primoidal trap range of mountains is quite sufficiently extensive. It continues, from Point Kew*a*wenon, at least 300 miles, to the Mississippi river, and occupies, irregularly, the space corresponding with that reaching from the St. Peters to the Chippewa rivers where they enter the Mississippi. And it is more than probable that the same range continues and forms the spurs of the Cordilleras, where the south-eastern Mexican mines are worked.

I would respectfully remark, that the stories of individual losses or gains at this business is no sort of a criterion of the probable result as a well defined, settled business, either as it respects the public good, or well directed private adventure.

If a man makes a miss by allowing his investment no ordinary chance of success, it does not argue that the country will produce nothing desirable; neither does it settle the question of the claims of the mining business to patronage with the prospect of profit.

On the other hand, some have made valuable *discoveries*, and a division of the risks among others has made the discoverer fortunate, without waiting the process of returns from the mines.

I have no doubt but that well directed explorations will continue to disclose new and valuable mines, and when the process of working



LITH. OF WAGNER & M'GUIGAN, 110, CHESTNUT ST. PHILA.

On the o... division of the risks among others has made the discoverer fortunate, without waiting the process of returns from the mines.

I have no doubt but that well directed explorations will continue to disclose new and valuable mines, and when the process of working

the ores shall have been brought to greater perfection, and a market opened at some convenient harbor on the lake, for the dressed ores, an extensive business will spring up, profitable to the adventurers, and highly useful to the American people.

Notes Appended.

It may be useful to append a few rough notes to the above remarks, for the benefit of any who may desire to avail themselves of the law of Congress adverted to, by first exploring the tracts to which they may claim the pre-emption, viz:—

In order to fit out an exploring expedition for the unsettled forests of Lake Superior, they should provide for each Company's location in one neighborhood, say—

1 good Mackinac boat, cost, perhaps, - -	$40
3 good boatmen, (half breeds,) who will also *pack* provisions and materials through the woods; wages, each, per month,	30
2 or 3 good miners, (one as foreman,) with tools for each location; wages, say, each, per month, - -	30
Tools, each, - - - - - -	5
2 tents, - - - - - -	30

Pork, flour, hard bread, tea, coffee, sugar, butter, peas, and beans, packing bags and cooking utensils for the camp, and a good supply of buffalo robes and Mackinac blankets constitute the outfit, with any additions in the way of "comforts" that the parties may fancy.

To visit that country, it requires an expense of time and money very nearly as follows, viz: Trip out:—

From Philadelphia to New York,	1 day,	$4	board extra.
" New York to Albany,	1 "	2	"
" Albany to Buffalo,	1 "	6	"
" Buffalo to Detroit,	1 "	6	and found.
" Detroit to Saut Ste Marie,	2 "	10	"
" Saut Ste Marie to Cliff mine landing,	1 to 2 days,	6	"
	7 to 8 days,	$34	

Thus requiring, besides expenses at stopping places, about $34, and say 8 days, more or less, of time, in going out to Copper harbor, Eagle harbor, or Cliff mine landing, at all of which places reasonable accommodations, for so new a settlement, may be had. The transit is by steam the entire trip, except three-fourths of a mile at the beautiful rapids of Saut Ste Marie. As a healthful pleasure excursion, I know of none that equals it. [The route *via* Pittsburg and Cleveland is shorter, and perhaps cheaper; but it includes about 120 miles of stage-coach fare, which to some is objectionable.]

BIBLIOGRAPHICAL NOTICE.

Gothic Architecture.

This style of building having of late become very much in vogue throughout the country, for ecclesiastical structures, it becomes important, to all who desire to keep pace with the taste of the age, to make themselves acquainted, at least, with its general principles and most striking peculiarities. To such of our readers who may be thus minded, we would say, that they will find, in the recent additions to our library, two very excellent little works on the subject, that are well worthy of their perusal and study. One is called "Anglican Church Architecture, by James Barr, Architect," and the other, "A Manual of Gothic Architecture, by F. A. Paley, M. A."

Both of these books are of a particularly readable character, and can scarcely fail to interest even those who are uninitiated into the art of which they treat, while, at the same time, such as are familiar with the principles and peculiarities of medieval architecture will derive pleasure from their perusal.

The Anglican Church Architecture, as its name indicates, is confined exclusively to the consideration of the ecclesiastical edifices of England, and is intended as an introduction to the study of those time-honored memorials of a tasteful and ingenious people. The several periods of Anglican medieval architecture are accurately described, and illustrated by numerous beautiful and spirited engravings, and the whole work is one well calculated to promote the diffusion of a correct taste in the peculiar species of architecture of which it treats.

Mr. Paley's work is intended to conduct the reader through the various eras of gothic architecture, showing the distinctive features of each, and presenting an analysis of details exceedingly useful to the student, and well adapted to interest those who are simply desirous to obtain a *general* knowledge of ecclesiastical antiquities. This work is also embellished with many spirited wood cuts, by which the descriptions are rendered intelligible to all classes of readers.

We have been induced to invite attention to these works by the fact that gothic architecture is very far from being well understood and appreciated by many who attempt to use it, its forms being often employed in the most incongruous connexions, and without any of the spirit and beauty that will be found, on close inspection and study, to belong to them.

T. U. W.

MECHANICS, PHYSICS, AND CHEMISTRY.

Gases and Explosions in Collieries.

The following interesting document is the report of a commission addressed by Lord Lincoln to Sir H. De La Beche and Dr. Lyon Playfair, for the purpose of obtaining information as to the best means of preventing, or mitigating, the fatal effects which are so frequently the result of the generation of noxious gases in coal mines:—

My Lord,—Having, in conformity with the instructions contained in the Earl of Lincoln's letter of the 27th of August, 1845, directed our attention to the composition of the gases evolved from coal beds, to the mode of ventilating collieries, and to the subject of explosions in them generally, we have the honor to submit the following statement for consideration.

With respect to the gases evolved from beds of coal, they may be viewed as the result of the continued decomposition of the vegetable matter from which coal is derived, a decomposition which may be regarded as still in progress under favorable conditions. Omitting the mineral substances, which, when burnt, are known as ashes, coal is essentially composed of carbon, oxygen, hydrogen, and nitrogen; and the quality of the coal depends upon the relative proportion of these ingredients. When the proportion of the carbon to the oxygen and hydrogen does not exceed about 75 per cent., the coal, in common terms, is called "bituminous," when the carbon amounts to about 85 or 90 per cent., it is termed "anthracite," or stone coal: or, in other words, the most advanced state of decomposition of the original vegetable matter bears the latter name.

During the decomposition a portion of the carbon is removed by its union with oxygen, forming carbonic acid, and another portion by combining with hydrogen, as carburetted hydrogen. Thus, by continued decomposition, the carbon gradually becomes a more important constituent in the remaining part of the original vegetable mass. The change from bituminous coal to anthracite can be produced artificially, and in a manner to illustrate the subject considered geologically. *

Though carbonic acid is, no doubt, found in many of our collieries in such a manner as to show it to be derived not only from the lights, horses, and workmen employed, but also to be partly the result of the progressive decomposition of the coal, it is with the carburetted hydrogen, or firedamp, as it is termed, that the collier has chiefly to contend. This comes upon him in various ways. Some coals more readily emit it than others, and hence they are locally termed fiery seams, beds, or veins. From some coals it would appear to escape more generally from the mass of the bed than from others, the gas gradually accumulating from the discharge over a wide surface. Other beds, again, are more fiery in the softer than the harder portions, and where joints or fissures are common. When two or more seams of

* Specimens in illustration of this, made by coking coal in a very gradual manner, are deposited in the Museum of Economic Geology.

coal, having different qualities, make up a workable bed, one will sometimes be more fiery than the other. Again, much depends, all other circumstances being equal, upon the kind of roof or covering rock of a coal-bed. If this be sufficiently porous, as many sandstones are, the conditions for the escape of the firedamp upwards through superincumbent rocks are more favorable than where the roof is composed of clay or argillaceous shell.

The dislocations of the strata, termed "faults" or "troubles," act frequently also as channels for the passage of the firedamp into the works, as they conduct the gas from coal seams beneath, which may be highly charged with it, although the seam under work may be free.

Although we may regard a large proportion of this gas as previously formed, and ready to escape when the necessary conditions, such as those of colliery workings, present themselves, we can scarcely suppose that carburetted hydrogen is not also formed during the time occupied by the progress of the same workings, much being evolved from the older portions of them. The manner in which splinters of coal are thrown off during the cutting of some beds has led to the hypothesis that the gas may be present in a liquid state, produced by condensation, so that when the needful pressure is removed during the progress of the work, the sudden expansion of the firedamp from a liquid to a gaseous form throws off the fragments. The force also with which the gas bursts suddenly forth from clefts or joints in some beds of coal is so considerable as to prove much previous compression, particularly when those bursts or blowers last only for a short time. When they continue for protracted periods, we may infer a more constant supply from continued decomposition of the coal, though the first sudden burst would point to compression. It has been inferred that the small cavities in which the fluid gas is confined can be detected by the microscope in some coals. It is probable that soft places, the sides of joints and fissures, and the walls or faults, are more favorable to the decomposition of the coal than its more solid portions.

The escape of firedamp is generally influenced by the barometrical state of the atmosphere, especially when much of the gas has become accumulated in the wastes or goafs. This is more or less experienced in all pits; but one striking case was pointed out to us by Mr. Jobling, of Jarrow Pit. In a pit of which he is the viewer, the gas issues from cracks in the roof of the seam, and in low states of the barometer is evolved in considerable quantity. When the barometer is high, instead of this issue of gas, there is a sensible current of air which enters into the cracks. When this inward current takes place, the pit is worked with naked candles; but when the evolution of firedamp commences, Davy's lamps are employed.

Assailed in this manner by a gas which, when mingled with atmospheric air in certain proportions, is highly explosive, a knowledge of its exact composition becomes a subject of great importance to the collier, since effective precautionary measures, more especially as regards the lights employed, must necessarily depend upon such knowledge.

Dr. Henry, Sir Humphry Davy, in this country, and Bischoff and others on the continent, have examined into the nature of the explosive gases of mines, but with results differing from each other; for while the English chemists found them to consist of carburetted hydrogen, with little or no admixture, the continental chemists have described them as very complex mixtures of olefiant gas, carburetted hydrogen, carbonic oxide, hydrogen, nitrogen, oxygen, and carbonic acid. On such a point ignorance would be culpable; and we were instructed to bring our knowledge up to the present advanced state of chemical analysis. Whilst we were engaged in this research, Professor Graham made a report to the Chemical Society on the same subject. The previous investigations of this chemist had rendered him well fitted for the task, and the results of his inquiries (according, as they do, with our own) amply guarantee that the subject, as far as relates to this country, may now be considered as decided, and show that the importance of an exact determination had simultaneously engaged the attention of the public.

It is unnecessary to describe in detail the methods which we pursued in the analysis; it may be sufficient to state that we adopted the methods mentioned in a report to the British Association on the analysis of gases by Professor Bunsen, and one of us. We may, therefore, at once tabulate our results, merely stating that we have devoted much attention to this investigation, so as to remove doubt upon a subject so important to the interests of the public. The gases were collected in various ways, some from blowers, others from the freshly exposed surfaces of the coal while the gas issued out with a singing noise, others from the explosive atmosphere of pits.

Gases.	Wallsend, from Pipe on Surface.	Wallsend, Bensham Seam.	Jarrow, Bensham Seam.	Hebburn, Bensham Seam. 161 fathoms deep.	Jarrow, Low Main.	Jarrow, 5·4 Seam.	Gateshead, Oakwell Gate, 5·4 Seam.	Coal 24 feet below Bensham seam, Hebburn Colliery.
Carburetted Hydrogen,	92·8	77·5	83·1	86·0	79·7	93·4	98·2	92.7
Nitrogen,	6·9	26·1	14·2	12·3	14·3	4·9	1·3	6·4
Oxygen,	0·0	0·0	0·6	0·0	3·0	0·0	0·0	0·0
Carbonic Acid,	0·3	1·3	2·1	1·7	2·0	1·7	0.5	9·0
Hydrogen,	0·0	0·0	0·0	0·0	3 0	0·0	0·0	0·0

The general result of this examination is, that the only inflammable constituent present in the explosive gas of collieries is carburetted

hydrogen or firedamp; there is not a trace of olefiant gas, and only in one out of the eight gases analyzed is there hydrogen. It follows, from the previous analyses, that the issue of firedamp into the atmosphere of a mine must deteriorate the air, by adding an undue proportion of nitrogen gas; in one case this gas amounts to 21 per cent. During an explosion the oxygen necessary to the respiration of the workers is removed by uniting with the carbon of the firedamp, and thus producing carbonic acid, a gas most fatal to animal life. This carbonic acid, mixed with the residual nitrogen of the atmosphere, and that present in the explosive gas itself, forms what is termed after-damp, which produces effects more fatal even than those arising from the explosion. It often happens, that after an explosion a sufficient quantity of oxygen remains to support the respiration of those who survive its effects, were it not for the presence of carbonic acid. This gas, when present in no greater proportion than one or two per cent., is capable of producing the most injurious effects. It has therefore been suggested, that cheap mixtures, made of substances capable of absorbing carbonic acid, such as glauber salts and lime, would prove useful to those who try to aid the sufferers after the explosion. Such a mixture placed in a coarse bag and applied to the mouth would effectually absorb the carbonic acid, and prevent it exercising an injurious effect on respiration. Certainly the want of some such precaution in the case of the Jarrow explosion caused the death of a very meritorious man, Jacob Difty, the overman of the pit.

An explosion is, however, generally attended with much more complex results than those described as attending the combustion of carburetted hydrogen. The amount of firedamp which may be first ignited may be trivial, and yet produce the most disastrous effects. From its lightness it accumulates at the upper part of the passages, and diffuses with considerable difficulty, often acting as a train, and communicating the explosion to the pent-up reservoirs of gas in the goafs. It is thus that in almost all accounts of explosions two are generally described as taking place; the first local, and at the seat of the explosion; the second more general, and aided by an accumulation of foul gas in other parts of the pit. In the case of Jarrow, the heat attending the explosion was so intense as to have thoroughly coked to the depth of nearly one quarter of an inch the coal lining part of the walls of one of the passages; an effect which could scarcely be conceived without supposing that the flame played for some time upon it with the intensity of a blow-pipe flame. The surface of coal thus acted upon was so considerable, that the amount of explosive gases evolved during this coking must have been far from insignificant, and may have aided the explosion itself. Add to this, that the first effect of the explosion is to blow up and ignite the immense quantity of coal dust lying about the pit, and not only produce from it an evolution of gas, but also occasion the production of much carbonic acid. And it cannot escape attention that the whole subject becomes involved in much complexity. It is known that a certain mixture of air with carburetted hydrogen prevents its accendibility; and, in the case of pure carburetted hydrogen, the proportion has

been ascertained to be not less than 15 times its own bulk. But the variation in composition of the firedamp of different mines, the uncertain modes of its issue, and the absence of any ready means of ascertaining its quantity, prevent any general rule being given as to the amount of air which should be thrown into mines to prevent the atmosphere ever attaining the explosive state. All this must be determined by practice to suit the varying conditions of different mines. It is certain that improvements might be made on the rude methods now in use for effecting the necessary mixture. The firedamp being, from its lightness, at the top, is not quickly influenced by the current of cold heavy air descending the downcast shaft, and circulating through the passages. It is therefore not unfrequent to see colliers flapping their jackets among this light gas, so as to dilute it with the sufficient quantity of air, and thus disturb the train of communicating gas which, in a foul state, may connect two dangerous parts of a pit. Mechanical contrivances, such as fanners, would more efficaciously produce the result than the inefficient extemporaneous means referred to; but, in general, such arrangements are only necessary when, from a defective ventilation, the current of air through the pit is not sufficiently strong.

Various artificial means have been proposed to facilitate the withdrawal of firedamp from a pit. Suggestions have been made to take advantage of the lightness of the gas by favoring its ascent to the upper parts of the pits, and drawing it off by special air ways. Pipes let down into the wastes have been proposed for the same purpose, while other suggestions have been made of pipes to blow in air at the tops of the passages, so as to cause the dilution of the gas.

We do not stop to consider these plans, because, as we have already stated, the conditions under which coal is worked are so numerous, that a plan which might prove useful in one pit would be wholly inapplicable and sometimes positively injurious in another, and the legislative application of any one plan might prove highly prejudicial to this great branch of national industry.

In 1835, a Select Committee of the House of Commons was appointed to inquire "into the nature, cause, and extent of those lamentable catastrophes from explosions which have occurred in the mines of Great Britain, with the view of ascertaining and suggesting the means of preventing the recurrence of similar accidents." Numerous witnesses were examined before this Committee, a body of important evidence collected, and a report published in the same year,—a report replete with valuable information, and to which we would wish to refer for ample details connected with the general mode of working collieries, especially in the north of England. The Committee observe, on the subject of colliery explosions, that while the loss of interrupted trade by these accidents is enormous, "it is nevertheless rather with reference to the cause and interest of humanity than in a pecuniary point of view that this inquiry has assumed its great importance." This Committee did not recommend any remedial measures.

The difficulty experienced of obtaining accurate information respecting the number of lives lost from colliery explosions within a limited

period is nearly as great at the present time as it was in 1835. And it should be borne in mind that the number of lives lost by the great explosions, those which chiefly become known and arrest public attention, by no means affords a correct view of the collective loss of life sustained by colliery explosions generally, including the minor accidents not commonly heard of beyond limited districts; neither does it represent the injury sustained by these explosions, short of the loss of life, but from which many persons are more or less disabled.

The Committee were enabled to ascertain that, during the 25 years preceding these inquiries, 2,070 persons had perished from colliery explosions; and they considered this number much underrated. During the last 10 years the rate of loss of life from this cause has certainly not diminished. The experience of the past year has shown that considerably more than 100 persons have been known to have thus perished.

It has so unfortunately happened that, during the few months we have been engaged upon this inquiry, two explosions, one at Jarrow, in Durham, and the other at Risca, in Monmouthshire, have together deprived 76 persons of their lives: 41 having perished at the former and 35 at the latter.

By direction of Sir James Graham and the Earl of Lincoln, we were commissioned to ascertain the causes of both explosions. It so occurred that, being at that time in the south of Ireland, engaged on the duties of the geological survey, Sir Henry de la Beche could not reach Jarrow in time for the inquiry, and therefore the investigation into the cause of the explosion at that place devolved upon Dr. Playfair, who, under these circumstances, availed himself of the services of Mr. David Williams, at that time one of the geologists attached to the geological survey of Great Britain, and well skilled in coal mining, but now in the service of the East India Company, examining the coal resources of India. The results of this inquiry are given in the accompanying report by Dr. Playfair.

Immediately after the explosion at Risca, on the 14th of January, 1846, instructions were again received to proceed without loss of time to that colliery. Dr. Playfair being, however, so engaged upon duties in London, that he could not readily proceed to Risca, the investigation was undertaken by Sir Henry de la Beche, aided by Mr. Warrington Smyth, mining geologist to the geological survey of the United Kingdom, who was in every respect qualified for such an inquiry. The accompanying report contains the results of this investigation.

During these inquiries it became very important carefully to consider the kinds of lights employed in collieries, and the usual regulations respecting them. The subject was not new to us, since for more than 25 years the mode of working collieries in different parts of the United Kingdom, as also on the continent of Europe, had engaged the attention of one of us. On the subject of safety lamps, of lighting generally, and of the regulations connected with it, the Committee of 1835 collected a large amount of evidence, more especially regarding our northern collieries. In the report of the South Shields Commit-

tee of 1843 there is also much information on this head. To these reports, therefore, we would wish to refer for sufficient information on the subject. Civ. Eng. & Arch. Jour.

(To be continued.)

On the Application of Gunpowder as an Instrument of Engineering Operations, exemplified by its use in Blasting Marl Rocks in the River Severn. By GEORGE EDWARDS.

[Read at the Institute of Civil Engineers.]

Many plans have been proposed at different times for the improvement of the Severn. It is sufficient, however, for the present purpose to state, that in 1842 an Act was obtained, under the advice of Mr. W. Cubitt, V. P. Inst. C. E., for the improvement of 43 miles of its length, from Stourport to Gloucester; over which distance, in many places, there was not two feet depth of water during the summer season. The object of the proposed works is to increase this depth to six feet of navigable water during all seasons. Above Worcester, the additional depth is obtained partly by dredging, but chiefly by a series of four weirs, varying between 300 and 400 feet in length, with side locks for the traffic. Between Worcester and Gloucester, (a distance of 29 miles,) it is proposed to obtain the required depth, partly by contracting the channel by embankments of fascines, and partly by dredging. Messrs. Grissell and Peto having undertaken the entire completion of the works, from Stourport to Gloucester, the superintendence of the dredging operations was entrusted to the author. The shoals to be removed by dredging are generally isolated, varying from 100 yards to half a mile in length, and they require excavating to a depth of from three to five feet. A large proportion of these shoals consists of alluvial gravel, without flints, but principally of quartzose and granitic pebbles, varieties of porphyry and of compact and granular sandstone. This material, although very hard in some places, offered no engineering difficulties. Other shoals consist of denuded beds of hard red marl; this material being found in every instance when the river impinges upon the eastern or western limits of its valley. In most places it was so hard as to render its removal by the dredging machine quite impracticable; and it is the object of the present communication to describe the method of blasting, or breaking up, this material, with gunpowder, so as to render it capable of being dredged up with facility.

That part of the river Severn, above described, traverses nearly north and south the great plain of red marl of the new red sandstone formation, the bed of the river, from Stourport to about a mile below Holt bridge, near Ombersley, being formed through the upper strata of the new red sandstone; upon this lies the great bed of red marl, (in places saliferous,) dipping at a small angle, but irregularly, to the south-east. The river traverses the whole of this strata, which is

probably more than 1000 feet in thickness, passing through the upper strata, and entering the lias formation above Gloucester.

The red marl is generally considered by geologists to be formed from the debris of older rocks, and it appears to be totally devoid of organic remains. It lies generally in beds, rarely exceeding 15 inches in depth, and often much less. It is divided occasionally by strata of greenish grey marl, and near the upper part of the formation by thin, but very hard, beds of shaly, or imperfect lias.

It is difficult to describe the comparative hardness of materials, but when it is stated, that in many places it was impossible to cause a steel chisel-pointed boring tool to enter it by any ordinary exertion, by hand, from a boat, it will be conceived that it could not be readily raised by dredging. After exposure to the action of the air, it breaks up into small fragments, almost like the slaking of lime, so that solid blocks, which could only be broken, by the application of considerable force, into sharp-edged fragments, would, in the course of a few days, fall to pieces, and afford no criterion of its hardness in an undisturbed state.

When the dredging machine was tried upon one of these marl shoals, it was found impossible to raise above 50 or 60 tons per day, and that with constant risk and repeated accidents to the machine; but such rate of progress was totally incompatible with the required progress of the work. Attempts were first made to break it up by driving iron bars into it, and prizing it up, but this plan did not answer. A second attempt was made to loosen it with a very strong plough, something like a "subsoil" plough, which was proposed to be pulled through the marl by a powerful crab fixed on a barge, the plough being guided by a strong pole; the effect produced was, however, so superficial, and the expense of labor was so great, that this method was also abandoned, and experiments were made to ascertain the effect and probable cost of using gunpowder. These were so satisfactory, that it was determined to blast all the marl shoals, previous to dredging them. In January, 1845, as soon as the requisite materials and establishment could be prepared, this operation was commenced, and has since been carried on with no other interruptions than those occasioned by freshes in the river; the total length of blasting required (about a mile and a half) being now nearly completed, and a considerable portion of the marl since dredged up, at the rate of 200 or 300 tons per day, with perfect facility.

The most economical method of using powder, to break up a depth of rock like that described, would probably be to obtain a face of the required depth at one end of the work, to put in a row of shots at the back of it, and after each discharge to remove the loosened marl; continually repeating the process; but this method would have been open to many serious objections. The dredging machine and the blasting gang would have been constantly waiting for each other, and, having but two dredging machines to perform the work, it was of great importance to economise their time in every possible way. By such proceedings, also, a constant obstruction to the navigation would have been created, equal to the whole width of the new channel. The num-

ber of men that could have been employed in blasting would also have been very limited. These objections, in this particular instance, far outbalanced any little saving of gunpowder. It was therefore determined to put in perpendicular shots, throughout the site of the channel, at such distances as experience might prove to be best, and proceedings were commenced with spaces of six feet from centre to centre of the shot holes.

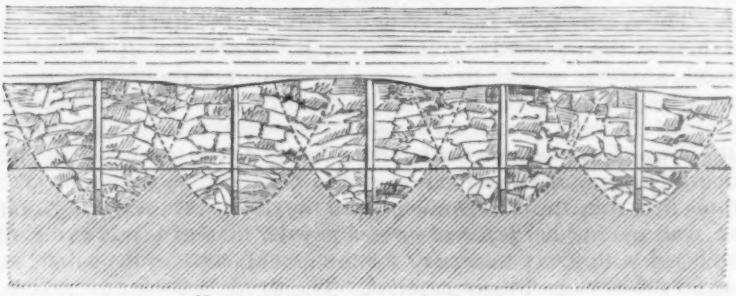
Six rafts were used, as stages to work from: they were each formed of four baulks of timber, about 40 feet long; the baulks, placed in pairs, were secured, at a distance of four feet apart, by cross pieces, six inches square, well spiked to the baulks at intervals of six feet; these were covered with deals three inches thick, laid lengthways of the raft, a space of 12 inches in width being left open along the centre. The ends of the rafts were provided with strong ring bolts to moor by. These rafts were confined to one bank of the river by ropes, and retained at the required distance from it, by a series of "sets," or booms, abutting against the bank. At the up-stream end of the raft, was a large barge fitted up as a blacksmith's shop, for the necessary repair of the tools,—with dwellings for the watchman, the ganger, &c. The bows of the barge were strongly fortified, and a strong oblique boom of large baulks reached from it to the shore, so as to protect the whole fleet from the craft coming down the river. At the down-stream end was another barge, fitted up as a powder magazine and as a shop, furnished with every necessary for the manufacture of the cartridges, and for the storing of their material. The words "powder magazine," in large letters, were painted on both sides of this vessel.

The first operation consisted in placing and securing, in their proper positions, the pipes through which the holes were to be bored. Small stakes, painted with a series of numbers, were first driven into the bank, parallel to the work, at distances of six feet apart; as far behind them as the slope would allow, was another row of stakes parallel with the first, so that a line drawn through two stakes would be at right angles with the river, and a person standing behind the two stakes could readily direct the workmen when to lower the charge-pipe, which was then secured in its place, in the opening of the raft, by a "timber-dog," driven into the raft on each side of it. The pipes were of wrought iron, drawn for the purpose by Messrs. James Russell and Sons, of Wednesbury: they were three and a half inches in diameter, three-sixteenths of an inch thick, and nine feet long.* Two collars, half inch square, were shrunk on them near the upper end, for the purpose of retaining a rope, by which they were secured when the charge was fired. When the depth of the water increased, these pipes could be lengthened four feet by an additional piece prepared for that purpose; this joint was made by shrinking on a collar, six inches long, over the joint. The pipe being in its place, was driven through any gravel that might remain and a few inches into the marl.

* Where the marl was so deep as to require three, or more, pounds of powder, it was found that the cartridges of such diameter as could be used in these small bores were so long as to lose part of the effect of the gunpowder; subsequently, pipes of 4 inches diameter were used with advantage.

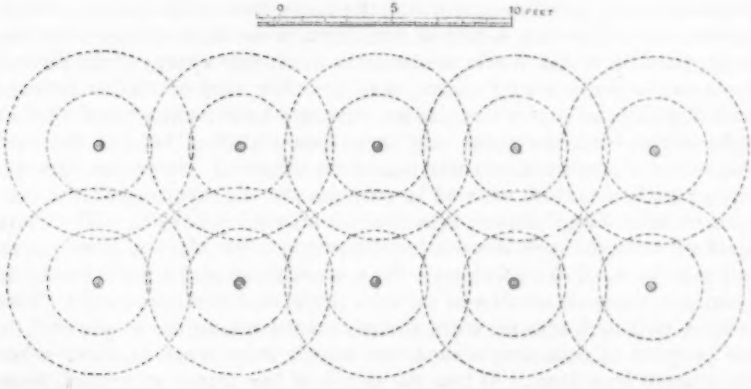
The gravel was generally so thick upon the marl, that it was requisite first to remove it, by means of the dredging machine. To protect the thin edges of the pipes whilst being driven, a cast iron cap, or plug, was used, which received the blows from a heavy wooden beetle; the interior of the pipes was next cleared of any sand, or gravel, that might have entered while putting them down. The principal tool used for this purpose was an iron bucket, or cylindrical tube, two feet in length, of as large a diameter as would pass down the hole; it was furnished, at the bottom, with a valve opening inwards, and was jointed to a round rod, of the requisite length, half an inch in diameter, and, when used with a pumping motion, quickly brought up whatever could not enter at the valve.

Fig. 1.



Horizontal line shows depth of dredging

Fig. 2.



The boring then commenced; a gang of three men being stationed at each pipe. The first operation was that of the jumper, which was made with a single steel edge, a little rounded. The jumpers were of round iron, one and one-eighth inch in diameter, except two feet in length at the lower end, which was one and a half inch in diameter. For general use, they were 15 feet long, and weighed about 52 lbs. each; after working them till they were nearly set fast, an auger was inserted to raise the plug of loosened marl, and to render the hole true.

The shell of the auger was 20 inches long, and nearly closed up, the better to retain the loosened borings.

The shot holes were bored two feet below the proposed bottom of the dredging, as it was supposed that each shot would dislocate, or break into small pieces, a mass of marl of a conical or parabolic form, of which the bore hole would be the centre, and its bottom the apex, so that four adjoining shots would leave between them a pyramidical piece of marl, where the powder would have produced little or no effect. By carrying the shot holes lower than the bottom of the intended dredging, the apex only of this paramid was left to be removed, and in practice this was found to form but a small impediment. (figs. 1 and 2.) A second reason was, that, if the removal of the shoals should cause the level of the summer water to fall lower than was expected, the marl might still be found sufficiently broken, to enable a greater depth to be obtained without further blasting.

The cartridges, or charges, were formed of strong duck or canvas bags, somewhat tapered at the bottom; these were filled with the required charge of powder, varying from two pounds to four pounds, according to the depth of the marl;* the end of a coil of Bickford's patent fuse was inserted to the centre of the powder, and the neck of the bag was carefully gathered up round the fuse, and well tied with small twine. If the cartridge was small, it was then dipped into melted pitch, which had about one-fourth of tallow melted with it, or otherwise the melted pitch was ladled over it, till it was uniformly coated; in this state, the cartridges were hung to drain and stiffen. When hard, they were well rubbed over with tallow, and lastly powdered over with dry whiting. The tallow, whilst it insured the stopping of any little cracks in the pitch, facilitated the passage of the cartridge down the hole; the whiting also prevented the pitch from adhering to anything. It has already been stated, that the powder was ignited by means of Bickford's patent fuse; but as this material is never made in lengths exceeding 48 feet, it was found expedient, in order to save waste, to use the whole coil, cutting it off at the requisite length when absolutely in the hole, and using the remainder in the same way, till the whole was used.†

The charge was carefully pushed down into the hole by a wooden ramrod of suitable diameter, with the end rounded; the same instrument was used for ramming down the tamping. The material found to answer best for this purpose was the small fragments of hard marl, separated by the action of the weather from the lofty escarpment at each of these shoals; this was gradually filled into the holes, and rammed solidly, till the bore was full up to the surface; the timber dogs which held the pipes were then removed, the pipes were loosened

* The weights of powder used for depths of four feet, four feet six inches, and five feet, were, respectively, about two pounds, three pounds, and four pounds.

† The short remaining ends, though useful for less depths, were of little value, from the difficulty of splicing them together. This operation, though troublesome, was resorted to with success on one occasion whilst waiting the arrival of a parcel of fuse. On returning the short ends to Messrs. Bickford they allowed half the length of new fuse in exchange.

from the marl, ropes were attached to the pipes and to the raft, or to some loose pieces of timber, and the shots were fired. Generally there was little external effect beyond the pipes being lifted a few inches, though sometimes they would be blown up several feet, and occasionally the water would be forced up through the pipe to a height of 40 or 50 feet. All the gangs commenced their holes in the morning, and they were generally all ready to fire at the same time, which was always done, as it caused least interruption to the work.

It was a rare occurrence for a shot to miss fire—probably not once in a hundred shots; the failure arising generally from a leak at the joint between the fuse and the bag. If the leak was not very serious, the shots were often saved by the following somewhat singular expedient. An iron bar, § inch in diameter and of sufficient length, pointed at the end, was kept in readiness, and when required the end was heated red hot, put quickly through the water into the tamping, through which it was driven as rapidly as possible into the powder, which in nine cases out of ten it was still hot enough to ignite.

The result of the whole work being invisible, great care was necessary in order to prevent mistakes and omissions. As each shot was ignited, a red mark was laid against its corresponding stake upon the bank; when it had gone off, each shot was carefully examined with a steel chisel-pointed searcher, to prove that the required effect had been produced to the determined depth; when so found, the red mark was inserted into the top of the stake, as a certificate of that shot having passed examination; the numbers so certified were then transferred to a book kept for the purpose, and if a shot was found ineffective, another was put in the same place.

To afford space for the workmen, every alternate hole was first made, and afterwards those which had been left between them; one line being completed, the whole line of raft was moved 6 feet outwards to the next line, and so on till the required width was obtained. The whole establishment was then dropped down the length of the rafts, and the process was repeated. When the men had become used to the work, each gang would sometimes get down four shots per day, so that with fifteen gangs sixty shots have been fired per day.

It may be objected to the use of the patent fuse, that the ignition of a number of charges simultaneously by the galvanic battery would have produced better effect, at less cost, and in a more scientific manner. The author commenced the work under a different impression, and subsequent experience with the battery has not altered his opinion. When it is required to separate a large stone from its bed in the quarry without breaking it, nothing can be better than the numerous simultaneous discharges, which can only be obtained by the use of the battery, but the object in this work, on the contrary, was to break the mass to pieces as much as possible, which it is conceived would be more likely to be effected by distinct discharges.

Then as regards cost: the patent fuse No. 3, carriage included, cost $\frac{6}{10}$ths of a penny per foot; if the average length is taken at 15 feet, that is just nine-pence per shot, a sum which would barely pay for making the arrangement of wires necessary for the galvanic igni-

tion. It was also found, from the compressible nature of the canvas cartridges, that the arrangement of the wires was very liable to be disturbed, during the insertion of the cartridge into the hole, or by the subsequent ramming of the tamping. After considerable experience, therefore, and the use of nearly 100,000 feet of the patent fuse, the author feels that he is only doing an act of justice to the Messrs. Bickford, in stating the perfect satisfaction which the use of their ingeniously manufactured material has afforded him, in the prosecution of the work now described.

There now only remains to be given the cost of the operation above described. The first cost of the establishment or plant, sufficient for 6 months' work, was £300. This includes the waste and use of timber, in the raft, stages, booms, &c., hire of barges, and cost of fitting them up for the work, cost of pipes for boring, iron and steel for tools, deducting estimated value when done with, sundry ironmongery, waste and loss of ropes and other small stores.

More than four thousand shots have already been fired, and in the six months, at a low computation, six thousand will have been fired. This number gives just one shilling per shot, as the proportionate share per shot of the cost of the plant; this would of course be much less if the work was to be continued.

The cost of labor per shot varies from 2*s.* 6*d.* to 4*s.*; this sum, however, must be understood to cover the wages of the whole establishment as under: Superintendent of the work—Foreman and timekeeper—Examiner of the shots—Maker of cartridge and two assistants—Carpenter—Blacksmith and Hammer-man—Laborers, some at 3*s.*, majority at 2*s.* 6*d.* and 2*s.* 9*d.*—Watchman.—Thus the total cost per shot is as under:—

Use of material, 1s.; labor, average, 3s. 3d.; pitched bag, 3d.; 3 lbs. of powder, at 5½d., 1s. 4½d.; 15 feet of patent fuse, 9d.; pitch, tallow, twine, coals, &c., say, 4½d.; making, together, 7*s.*

If, therefore, the shots are 6 feet apart, and an average depth of 3 feet is broken up, 4 cubic yards are prepared for dredging at the cost of one shot; or the cost of the whole operation is 1*s.* 9*d.* per cubic yard. Distances of 5 feet apart were used in some very hard shoals, and spaces of 7 feet were tried in some that were softer than usual; spaces of 6 feet apart, however, appeared to be generally sufficient.

Civ. Eng. & Arch. Journal.

The Manufacture of Ruby Colored Glass.

[The following conclusion of an article on the art of glass painting, published in Beckman's History of Inventions, is copied from the London Mechanics' Magazine. The reader will find much on the manufacture of glass, both white and colored, in the previous volumes of the Journal of the Franklin Institute, particularly the 9th, 10th, 11th, and 12th volumes of the present series. Com. Pub.]

I shall now conclude these observations by a few notices respecting glass tinged by fusion with gold, which, though never brought into general use among glass painters, has, I know, been employed in one